53D CONGRESS, 2d Session. } HOUSE OF REPRESENTATIVES. { REPORT No. 913.

SHIP CANAL FROM THE GREAT LAKES TO THE NAVIGABLE WATERS OF THE HUDSON RIVER.

MAY 17, 1894.—Committed to the Committee of the Whole House on the state of the Union and ordered to be printed.

Mr. CHICKERING, from the Committee on Railways and Canals, submitted the following

REPORT:

[To accompany H. R. 4476.]

The Committee on Railways and Canals, to which was referred the bill (H. R. 4476) for ascertaining the feasibility and probable cost of constructing a ship canal from the Great Lakes to the navigable waters of the Hudson River, having had the same under consideration, report the same back with the recommendation that it do pass with the following amendment:

In line 10 strike out the words "one hundred" and insert in lieu thereof the word "fifty."

This committee finds that the bill is identical with H. R. 283 of the Fifty-second Congress, which was favorably reported by the Committee on Railways and Canals. A full and exhaustive report was then made, which your committee presents herewith as a part of its report.

House Report No. 1023, Fifty-second Congress, first session.

Mr. BENTLEY, from the Committee on Railways and Canals, submitted the following

REPORT:

[To accompany H. R. 283.]

The Committee on Railways and Canals, to which was referred the bill (H. R. 283) for ascertaining the feasibility and probable cost of constructing a ship canal from the Great Lakes to the navigable waters of the Hudson River, having had the same under consideration, report the same back with the recommendation that it do pass.

The bill directs the Secretary of War to cause to be made accurate surveys, examinations, and final estimates of cost of construction of a ship canal by the most practicable route, wholly within the territory of the United States, from the Great Lakes to the navigable waters of the Hudson River, of sufficient capacity to transport the tonnage of the lakes to the sea, and appropriates the sum of $100,000, or so much thereof as may be necessary, to defray the expense of such surveys and estimates.

One hundred and fifty miles northwest of Duluth and Superior are the fountains of three of the great drainage systems of the American Continent. From there the flowing waters are sent northward to the ocean through Hudson Bay; southward to the ocean through the Mississippi Valley and the Gulf, and eastward to the ocean through the Great Lakes and the St. Lawrence.

For commercial purposes the northern drainage system is impracticable and useless; but flowing water is now, and forever will be, the potential agency of commerce southward and eastward between the interior and the Atlantic coast.

The Great Lakes contain more than one-half the area of the fresh water of the globe. They make up the world's largest system of deep-water inland navigation.

Embracing nearly 100,000 square miles of connected waters, with a general direction east and west, between the forty-first and forty-seventh parallels, they penetrate from tide water on the St. Lawrence and (including the Erie Canal) from tide water at New York 1,400 miles into the heart of the continent. The head of Lake Superior and the St. Lawrence tide water are on the northernmost parallel, Chicago and New York on the southern. The western extremity of the system is 1,700 miles only from the waters on the Pacific. The range of this water system, it will be observed, is entirely within the limits of the north temperate zone, on the line on which population most freely moves

westward, and where final settlement is most compact and where the climatic conditions insure the largest returns to capital and labor. For one-half the distance between the two oceans these waters divide the Dominion from the Great Republic. Eight States, with a population of 26,000,000 people, border on these lakes, and more than 6,000,000 people in the West and Northwest besides largely depend upon them.

Kansas, Nebraska, Colorado, Iowa, Wisconsin, Minnesota, the Dakotas, Wyoming, Montana, and the northwest Canadian provinces, by means of their railway connections, are largely tributary to these waters.

The traffic of these Great Lakes is simply amazing. Through the Sault Canal, at the outlet of Lake Superior, there passed in 1890 10,557 vessels, having a net registered tonnage of 8,454,435 tons. The actual freight tonnage was 9,041,213 tons, but the registered tonnage is used for the purpose of comparison. Through the Suez Canal there passed during the same year 3,389 vessels, having a net registered tonnage of 6,890,014 tons, so that nearly three times as many vessels and over 1,500,000 tons more of freight passed through the Sault Canal, away in the center of the continent, than passed through the Suez Canal, which is an international work and a highway for the commerce of the world. And it should be remembered, too, that the Sault Canal was open but two hundred and twenty-eight days for navigation and the Suez Canal was open, of course, during the entire year. And this represents the business of Lake Superior alone.

The entries and clearances in New York in 1889 represented 11,051,236 tons, and the entries and clearances in all the seaports in the United States represented 26,983,315 tons. The entries and clearances from London and Liverpool during that year were 33,430,617 tons. The entries and clearances on the Great Lakes in the same year were, according to the United States census, 27,700,000 tons; and in 1890 the total freight traffic of the Great Lakes was 33,303,324 tons, exceeding by 6,000,000 the combined entries and clearances of all the seaports of the United States, Atlantic, Gulf, and Pacific, and equaling the combined entries and clearances, both coastwise and foreign, of London and Liverpool, the great commercial centers of the world.

These shipments embraced 9,000,000 tons of iron ore, 5,000,000 tons of grain and flour, 8,000,000 tons of lumber and forest products, 7,000,000 tons of coal, and 4,500,000 tons of miscellaneous freight. This was carried by a floating equipment of 2,784 vessels, having a carrying capacity of 1,254,275 tons, and a commercial value of $48,809,750.

Of the total tonnage of shipping built in the United States during the year ending June 30, 1889, 5 per cent was built on the Western rivers, 8 per cent was built on the Pacific coast, 41 per cent on the Atlantic coast, and 46 per cent was built on the Great Lakes.

The ton mileage of the Lake marine for the season of 1889 was 15,518,360,000; and in 1890 it amounted to 18,849,681,384. The ton mileage of all the railways in the United States for 1889 was 68,727,223,146. It is thus seen that the ton mileage of the Lake marine is more than one-fourth that of all the railways in the United States. The average rate of charges for freight received by all the railways of the United States for the year 1890 was 9 mills per ton mile and at that rate the transportation by rail of the Lake cargoes would have cost $169,647,132.

The average rate on all freights carried upon the Great Lakes is not over 1.2 mills per ton mile, making the total cost of water transportation $22,619,617.66 equal to an economy over the cost of transporting the same freight by rail of $147,027,514.

Mr. S. A. Thompson, secretary of the Duluth Chamber of Commerce,

who has given profound study to the subject, and to whom indebtedness is acknowledged for many facts and expressions of thought, says:

Careful experiments, conducted for a long period on the Grand Trunk Railway, showed the actual cost of moving freight, exclusive of fixed charges, to be 0.5 cent per ton per mile. The average cost on all the roads reporting to the Interstate Commerce Commission for the fiscal year ending June 30, 1890, was nearly 20 per cent greater, being .593 cent per ton per mile, while the lowest cost I have been able to find on record is in the case of the Lake Shore and Michigan Southern, which has been able in exceptionally favorable years to report a cost as low as 0.4 cent per ton per mile. On the Erie Canal the cost is only half as much as the least cost reported for rail transportation, being 2 mills per ton per mile. On some of the Belgian canals, where steam towage is used, the cost has been reduced to 1½ mills, while on the Aire and Calder Canal, in England, General Manager Bartholomew, who seems to be the greatest genius in canal management which the world has yet produced, reports that he has been able to reduce the cost of transporting minerals to 0.024 cent per ton per mile, and for general merchandise to 0.068 cent, the average being 0.064, and the cost of returning the empties being included in each case.

The figures grow more and more interesting as we go on, and when we turn to the Great Lakes, where we have deeper water, we find results which are almost startling. * * * The lake boats carry 2,700 tons of freight on the present depth of water at the Sault, make the run from Duluth to Buffalo in three days and a half, and cost on an average of $120 per day. Calling the distance from Duluth to Buffalo 1,000 miles, and we find these figures are equivalent to 0.015 cent per ton per mile, only one twenty-sixth the cost on the Lake Shore road. Or, to express the same fact in terms which will be better understood by the ordinary business man, it costs $26 on the most favorably situated railroad in the United States to do what is done on the Great Lakes for $1. These figures, and hundreds more like them which could be given if necessary, prove conclusively to my mind that it is utterly impossible for the railway to compete on even terms with the water way for the carriage of bulk freights, and, second, that the greater the depth of the water way and the greater the carrying capacity of the canal boat or vessel the less is the cost of transportation.

Within the past two years a revolution in methods of transportation of grain by water has been effected by means of the "whaleback" vessels, arising from lessened cost of construction, reduced expense of maintaining and operating, largely decreased consumption of coal, and having capacity for carrying much larger cargoes of grain.

One of the "whaleback" steamers, with two barges in tow, went through from Duluth to Kingston this last season, unloading at that point onto barges that carried the grain as usual through the St. Lawrence canals to Montreal, and the total rate from Duluth to Montreal was 5½ cents per bushel. The "whaleback" steamer went, without cargo, through the St. Lawrence rapids in all places where the canals are incompleted; and where these are completed of the dimensions at present projected by the Dominion Government, she passed through them to Montreal, took her cargo on once more, and carried from Montreal to Liverpool about 90,000 bushels of wheat.

An obvious advantage of such a vessel is that when loaded with such a cargo she drew less water than an ordinary vessel capable of carrying such a cargo would draw without any load.

With a canal from the Lakes to the Hudson, of sufficient capacity so that these vessels could pass through without breaking bulk, the cost of carrying wheat from the head of Lake Superior to the city of New York will be less than 5 cents per bushel.

This economy in transportation affords an increase in the price of the products of the soil to the farmers of the great Northwest. It brings to the people in the densely populated manufacturing districts of the East cheaper breadstuffs. It gives living wages to the miners of Lake Superior and reduces the cost of manufactured iron. It fosters the great shipbuilding industry in the cities bordering on the Great Lakes, an industry which, within the past ten years, has changed a modest

fleet of small wooden schooners to a magnificent squadron of steel steamships, fit to circumnavigate the globe, designed by American architects, built by American capital and American workmen, manned by American sailors, owned and operated by American citizens, and carrying the products of American soil and American industry.

On the day that it becomes possible to send ships direct from the Great Lakes to the ocean by way of the St. Lawrence River, while they are unable to go from the Great Lakes to the ocean by the way of the Hudson River, the sceptre of commercial supremacy in the Western Continent will begin to pass from New York to Montreal, and the merchant marine of the United States, which has had a new birth on the Great Lakes, will receive its death blow from Canadian competition.

It is not a question whether the products of the West and Northwest shall go by way of the Erie Canal or by rail from Buffalo to New York or not go at all, but whether the transportation of these products shall be retained in American hands on American soil and reach an American seaport or whether it shall be surrendered to Canada.

Who shall control the resistless tide of this expanding commerce which demands an outlet to the sea?

When the Great Lakes have a connection with the ocean through Canadian soil the cities on the lakes will become seaports for Canadian vessels, while American vessels have no means of reaching them. This means that every bushel of grain and every barrel of pork for export from the great West will be taken by Canadian vessels from Chicago, Milwaukee, or Duluth either direct to Liverpool or for transshipment at Montreal. It would necessarily take this route because the Erie Canal could afford no competition against 14 feet depth of water of the Welland and St. Lawrence canals. Breadstuffs and provisions constitute so large a percentage of our entire exports that the vessels carrying these must necessarily be the ones to return our imports in.

The supremacy of England rests not so much in the fighting strength of her navy or her enormous accumulation of capital as on the fact that her capital has been directed to securing the carrying trade of the world and that her naval strength has been used to protect her commerce. What England has done for the world at large Canada is endeavoring to do for this continent. In proportion to her population and resources, the expenditures of the Dominion in developing both rail and water ways have been enormously greater than those of the United States. With less than one-twelfth of our population, in a less favorable climate, and with natural resources far inferior to ours, she has fearlessly grasped her great and difficult transportation problem. On her water ways she has expended, largely on this lake system and the St. Lawrence, $54,596,180. She has built and equipped 1,217 miles of railway at a cost of $54,557,579. With 12,628 miles of railway in operation, the government has given to railways in—

Bonuses	$135, 894, 304
Loans	21, 201, 314
Provincial government	24, 036, 307
Municipalities	13, 461, 224
	194, 593, 149
In all for railways	246, 150, 728
In all, railways and canals	300, 746, 917

In England $60,000,000 are now being expended to connect one city with the sea, Manchester and Liverpool.

Germany, in 1887, ordered the construction of more than 1,000 miles

of new canal navigation in addition to the 1,289 miles then operated and the 4,925 miles of then available navigable rivers.

France has expended since 1814 upon the improvement of her harbors and water ways more than $650,000,000, in addition to $700,000,000 out of the state treasury for railways. She has 7,500 miles of canal and river navigation and the completest transportation facilities of any nation in the world. She commenced building canals a hundred years before the Christian era, when Marius caused his soldiers to excavate from the Rhone to the sea a canal that long bore his name and to which the city of Arles chiefly owed its splendor.

The total appropriations of the United States Government for rivers and harbors have been $204,137,649. They began in Jefferson's administration, 1800, with $25,000, in the State of Louisiana. The sum of $14,699,745 was expended previous to 1860. Between 1860 and 1870 the amount was $12,789,182; between 1870 and 1880, $68,035,656; be- 1880 and 1890, inclusive, $108,613,066, or only $204,000,000 in a century for great objects of national development. Of this total amount $28,417,182 only have been expended within the great States bordering on this lake system and for its improvement.

In relation to this portion, at least, of the total appropriations for rivers and harbors since our national life began it may safely be asserted that the expenditure for public purposes of no equivalent sum elsewhere on American soil has ever resulted in so large and so equitably distributed advantages to the American people.

The development of the water ways should be made, not only because the water way furnishes the cheapest possible form of transportation, but because it is also the most powerful possible regulator of railway rates. On roads subject to water competition freight rates invariably go up when navigation closes in the fall, and go down again when navigation reopens in the spring.

The last annual report of the collector of customs of the port of Buffalo shows that at the close of canal navigation in the fall of 1891 there were 10,000,000 bushels of grain at that port awaiting shipment east to be forwarded by rail.

The average freight rate on grain from Buffalo to New York by canal during the season of navigation was 4¾ cents a bushel, and just before the close it was but 3½ cents. During navigation the rate by rail was kept down to that by canal, but within a day after the last canal boat had cleared the rail rate was advanced to 7½ cents a bushel, an increase of 4 cents. That meant that the Eastern consumers must pay $400,000 more than would have been charged them had the grain gone all the way to New York by water.

A very carefully prepared table shows that the average freight rate on grain by lake from Chicago and Duluth to Buffalo during the past season was about 4 cents a bushel, 3½ cents less than the railroads wanted for carrying grain one-third of the distance, or from Buffalo to New York.

It should be noted also that the influence of water competition is not confined to the roads which lie close along the water way. Mr. Albert Fink, the railroad commissioner, used the following words in 1878, in a letter addressed to Hon. William Windom, who was at that time chairman of the Senate committee on transportation routes to the seaboard:

> You are aware that when the rates are reduced between Chicago and New York on account of the opening of the canal, this reduction applies not only to Chicago, but to all interior cities (St. Louis, Indianapolis, Cincinnati), to New York. If that was not the rule the result would be that the roads running, say, from St. Louis,

Indianapolis, and Cincinnati, to Chicago, would carry the freight to Chicago, from which point low rates would take it to the East and leave the direct road from the interior points to the seaboard without business. Hence, whenever the rates are reduced on account of the opening of navigation from Chicago and lake ports, the same reduction is made to all interior cities, not only to New York, where the canal runs, but to Philadelphia and Baltimore. Although the latter cities have no direct water-route communication with the West, yet they receive the benefit, as far as railroad rates are concerned, the same as if a canal were running from the lakes direct to the cities, because whenever rates from Chicago to New York are reduced it is necessary to reduce the rates from Chicago to Boston, Philadelphia, and Baltimore; otherwise the business would all go to New York.

The reduction of the rates from Chicago and St. Louis to Baltimore causes a reduction in rates on shipments via Baltimore to Atlantic ports—Norfolk, Wilmington, Savannah, Brunswick, and Fernandina, and from there into the interior of the Gulf States—Augusta, Atlanta, Macon, Montgomery, Selma, etc. * * * These roads * * * are obliged to follow the reductions made via the Baltimore road, and which were principally made on account of the existence of the Erie Canal and the opening of navigation. The same way in regard to the west-bound business, * * * so that it may be said that the rail rates are kept in check by water transportation.

Nor is water competition confined in its effect entirely to the season of navigation. The same authority last quoted testified before the Senate Committee on Interstate Commerce that, at least so far as grain rates are concerned, that influence extends throughout the winter. "For," said he, "if the rail rates are made too high, the grain is simply stored to await the drop in rates which is certain to come when navigation is opened."

It is wonderful to see in how many different directions and to what a distance the influence of the water way extends. We have seen that it not only gives the cheapest form of transportation, but that it exerts a powerful influence on the railways which parallel the water route, whether close by or hundreds of miles away, and that this influence is felt even during the time when the water way is frozen up. And even this is not all. The beneficial effect of the water way extends also to the interior of the country, which is reached only by railway lines which terminate upon the water way and make a through line for the transportation of freight in connection therewith. At the same time all the experience of the past proves that the development of the water ways is not an injury but a benefit to the railway business.

The New York Central and Lake Shore and Michigan Southern Railways, considered as one, lie close alongside a water way almost every mile of the distance from New York to Chicago, and there is no other railway in the United States which has been compelled to build four tracks to accommodate its business as the New York Central has. In Germany, the year following the great improvement in the river Rhine, the traffic of the river increased 30 per cent, while the traffic of the railway along its banks increased 60 per cent. As a matter of fact, the two systems of transportation, rail and water, are not antagonistic, but complementary each to the other.

A great misconception has existed in the minds of many as to the agricultural possibilities of the Canadian northwest. The fact is that the very finest wheat is grown in the Peace River Valley, 1,500 miles northwest of Duluth, and there are millions of acres of land on which the finest small grains in the world can be grown in the Canadian northwest, and the time is not far distant when the wheat growers of Kansas and Nebraska and the Dakotas must meet Canadian competition in supplying with wheat the markets of the world.

If, when the time comes, the Canadian farmers can send their wheat 500 miles by rail to Lake Superior, breaking bulk but once between the farm wagon and the Liverpool docks, while the farmer of Kansas and

Nebraska must send his wheat 1,200 or 1,500 miles to reach the ocean vessels, there can be no question as to who will win in such an unequal competition. It is not only the proper policy, but it is one of the highest duties of our Government to see to it that the farmers of the United States shall have as cheap transportation for their products to the seaboard and to the markets of the world as is enjoyed by the people of Germany or France or Canada or any other nation under the sun.

The Welland Canal and a portion of the St. Lawrence Canals have already been deepened to 14 feet, and work is in progress to bring the remaining canals of the St. Lawrence system to the same depth. The canal through the St. Clair Flats, and the magnificent locks of the American Canal at the Sault are as free to Canadian vessels as to our own, but in spite of this fact the Dominion is building a new canal at the Sault on the Canadian side of the river. Within five years from the present time, at the present rate of progress, and within three years if the work is hastened a little, there will be a clear channel for vessels drawing 14 feet of water through Canadian territory all the way from Lake Superior to the sea.

Six feet of water in the Erie Canal and two transfers of the freight can no more compete with 14 feet of water through the Canadian canals and no transfer than a wheelbarrow can compete with an express train.

The canal boat carrying 200 tons, drawn by mules at the rate of 4 miles per hour, can by no possibility compete with the steamship carrying 2,000 tons, propelled by steam at rate of 14 miles per hour. And while the American farmer has held his own fairly well against the semi-civilized wheat growers of India, how can he hope to win in competition with men of the same race, men just as intelligent, with a climate no more rigorous, with a soil at least as fertile, and with transportation facilities immeasurably superior? The great plains of the Canadian northwest are unsettled now, but when once the conditions of soil and climate which there exist are supplemented by facilities for transportation not surpassed, if equaled, by those of any other region, the Canadian northwest will settle up with a race of hardy, intelligent, and prosperous people, and will become the granary of the world. He who can most cheaply reach the markets of the world can control the markets of the world.

It is not alone the commercial advantages of a water way upon domestic territory from the Great Lakes to a domestic seaport that are involved. It is a national question of the utmost importance and in the broadest sense. In a report of the Military Committee of the House, published in 1862, it is stated that—

The United States and Great Britain are equally prohibited by treaty stipulations from building or keeping afloat a fleet of war vessels upon the lakes. At the same time, on the shores of these lakes the United States have many wealthy cities and towns, and upon their waters an immense commerce; these are unprotected by any defenses worthy of special notice, but are as open to an incursion as was Mexico when invaded by Cortez. A small fleet of light-draft, heavily armored gunboats could in one month, despite of any opposition that could be made by extemporized batteries, pass up the St. Lawrence and shell every town and city from Ogdensburg to Chicago. At one blow it could sweep our commerce from that entire chain of waters. To be able to strike a blow so effective Great Britain constructed a canal around the Falls of Niagara. By this single stroke the entire chain of lakes was opened to all British light-draft ocean vessels.

Perceiving our ability to erect works upon the St. Lawrence that might command its channel, and thus neutralize all they have done, Great Britain dug a canal from the foot of Lake Ontario on a line parallel to the river, but beyond reach of American guns, to a point on the St. Lawrence below, beyond American jurisdiction, thus securing a channel to and from the lakes out of our reach. Occupied by our vast

commercial enterprises and by violent party conflicts, our people failed to notice at the time that the safety of our entire northern frontier has been destroyed by the digging of two short canals. Near the head of the St. Lawrence, the British, to complete their supremacy on the lakes, have built a large naval depot for the construction and repair of vessels, and a very strong fort to protect the depot and the outlets of the lake, a fort which can not be reduced—it is supposed by them—except by regular approaches. The result of all of this is that in the absence of ships of war on the lakes, and of means to convey them there from the ocean, the United States, upon the breaking out of war, would, without navy-yards and suitable docks, have to commence the building of a fleet upon Lake Ontario and another upon the Upper Lakes. At the same time, England, possessing a naval depot at the entrance to this system of waters, can forestall us in all our attempts, both offensive and defensive.

Thirty years have gone by since these words were written, and while the size and importance of these cities and the commerce of these waters have amazingly increased, this mighty commerce and these majestic cities are even more defenseless than they were then. More than a hundred vessels in the British navy are capable of passing through the Canadian canals from the sea to the lakes.

Canada is even now building cruisers which are a menace to our lake commerce.

A dispatch from Ottawa, dated March 6, 1892, published in the New York Recorder, of March 7, says:

The Dominion Government is about to place three new cruisers on the Upper Lakes. One will be located on Lake Superior and one at least on Lake Huron.

The Washington correspondent of the same paper says:

The Treasury Department some time ago made an official inquiry as to the character of the three new revenue-cutters now being built by Great Britain on the Canadian side of the Great Lakes. In an official report to the Treasury Department an officer of the Revenue-Marine Service states that the *Constance* is the type of a number of vessels about to be built.

Her dimensions are: Length, 125 feet; beam, 19 feet 3 inches; draft, 9 feet; engines of the single-screw, vertical, compound type, cylinders measuring, respectively, 18 and 36 inches; stroke, 24 inches; battery, three Nordenfeldt rapid-fire guns.

SHE HAS A RAM.

The *Constance* has a ram bow, and special attention has been paid to the arrangement of her bunkers in order to protect the machinery from shock. Two vessels of the *Constance* type are now afloat. This type of vessel is more formidable than any of the revenue-cutters of the United States, and the fact that England is building these semiwarships for the lake service has not escaped official attention.

The same paper, in its issue of March 8, 1892, in its Washington correspondence, under date of March 7, says:

THOSE WAR SHIPS.

The character of the revenue-cutters, as ascertained by the official investigation conducted by the Treasury Department, is believed by those who have looked into the question closely to be a violation of treaty rights to which the United States ought not to submit without some kind of a protest. Each one of the projected revenue-cutters would be available in case of hostilities for the purposes of actual warfare, and would far outclass any vessels which would be at the disposal of the United States on the Great Lakes.

Their presence in the lakes will be a constant menace, and as they are not needed for the legitimate objects of the revenue service, it is the opinion of Representatives and Senators who have been approached upon the subject to-day that Great Britain should be asked respectfully but firmly to explain their presence on the lakes, and if that explanation is not satisfactory, to abandon the idea of launching them.

Any action of the Canadian Government looking to a strengthening of its forces in that quarter of the world just at the present time, when the Bering Sea question has reached so critical a stage, can not, in the judgment of public men in Washington, be regarded with equanimity.

With the resources thus available to the British Government, she might put into the lakes vessels enough to besiege at one time every city from Ogdensburg to Chicago and Duluth, and sweep the commerce of the United States from their waters, unless prevented by a destruction of the Canadian canals by the United States in anticipation of any act or declaration of war.

In building and enlarging the Erie Canal, New York alone has expended $50,000,000 and given a free water communication from the lakes through the Hudson to the sea.

This has been one of the most potential influences of American progress and civilization. It developed the Northwest by giving an outlet to the commerce of the Great Lakes. It made New York the Empire State and her metropolis the imperial mart of the New World. It made possible the great cities of Chicago, Milwaukee, Cleveland, Toledo, and Buffalo.

When that famous undertaking was commenced there was but one steamer upon Lake Erie. Huron and Michigan were known only to the Indian and the fur traders. Buffalo, a city of over 250,000 souls, was then a village, and Chicago and Milwaukee were yet "in the womb of time."

The whole commerce above Niagara upon nearly 100,000 square miles of water, with 4,000 miles of coast, employed but forty sail, two only of which exceeded 100 tons. Yet in the policy then inaugurated by New York's famous governor, De Witt Clinton, the barriers interposed by nature between the commercial intercourse of central North America and the world were broken down and now the glistening waters are bedecked with hundreds of floating palaces propelled by steam and thousands of sailing vessels with a tonnage exceeding the foreign and coastwise commerce of the whole nation.

Contemporaneous with the enlargement of the Erie Canal began that wonderful development of the railway system of transportation, which has so increased that the canal, which has remained practically unchanged for thirty years, is gradually losing its capacity for usefulness and its influence upon the problem of transportation; but its creation and existence has demonstrated the possibility of a union of the lakes with the Hudson, and illustrated the value and importance of a far more radical and extensive improvement to meet the present and prospective wants of the mighty tide of lake traffic which demands an adequate outlet to the sea.

Whether this can be done at all, or whether it can best be done by enlarging the Erie Canal, or by a ship canal around Niagara Falls connecting lakes Erie and Ontario, and then by the Oswego and Mohawk river routes to the Hudson, or whether any plan whatever is feasible, and if so what would be the probable cost of such a work, are the important questions to be first determined.

Congress after Congress has been importuned to make appropriations for some part of the work which forms a feature of the whole enterprise; to deepen the channels between the lakes; to build the Niagara ship canal; to deepen the waters of the upper Hudson, and to enlarge the Erie Canal. Men of the highest standing as engineers, of the widest experience as shippers, men of the broadest intelligence, have expressed their views, but yet so far as cost and practicability are concerned they remained opinions merely.

To determine the feasibility of constructing a deep water way from the lakes to the Hudson, its probable cost and the sufficiency of an available water supply, can only be settled by a detailed and carefully

planned survey. And such a survey should embrace every available route which is wholly within the territory of the United States, in order to definitely settle which is the best and most economical.

The importance of this measure has been repeatedly brought to the attention of Congress by proposed measures looking to the building of a ship canal around Niagara Falls, connecting lakes Erie and Ontario, and the other project of direct connection of Erie with the Hudson by way of an enlargement of the Erie Canal, avoiding the Ontario, while still another project, embracing the idea of the Niagara ship canal and the enlargement of the Oswego Canal, and from its junction with the Erie and enlargement of the latter to the Hudson. Still another, and apparently the most feasible plan, is that of including the Niagara ship canal and a new canal from Oswego, which shall embrace Oswego River, Oneida Lake, and the Mohawk River to the Hudson.

The attention of the country has been called to various phases of the question from time to time; first as early as 1784, one year after this nation had achieved recognition from Great Britain. In 1808 a resolution of the Senate called upon the Secretary of the Treasury, Albert Gallatin, to report proposals for internal improvements worthy the action of Congress. In his report he recommended the construction of a ship canal around Niagara, and says of it:

> No other single operation within the power of the Government can more effectually tend to strengthen and perpetuate that union which secures external independence, domestic peace, and internal liberty.

This was at a time when the immense population and resources of the West were unknown and scarcely dreamed of, when western New York was almost a wilderness, and there was no city and no commerce upon the Great Lakes needing defense in case of foreign war.

The execution of this plan was suspended by the interruption of friendly relations with Great Britain. But immediately with the restoration of peace President Madison, in his annual message, dated December 3, 1816, said:

> I particularly solicit the attention of Congress to the expediency of exercising their existing powers, and, when necessary, of resorting to the prescribed modes of enlarging them, in order to effectuate the comprehensive scheme of roads and canals (including Niagara) such as have the effect of drawing more closely together every part in the common stock of national prosperity.

This portion of the message was referred to a special committee, who made what has been called an "enlightened and patriotic" report, in which the great valley of lakes is particularly spoken of as "the grand theater upon which the General Government was destined, at no remote period, to act a distinguished part in effectuating one of the greatest schemes of internal navigation the world ever beheld."

In 1835 a Government survey, contemplating a canal of 10 feet in depth around Niagara, was made by Capt. W. G. Williams, United States topographical engineer, pursuant to an order of the Executive, and his report placed the feasibility of the work as then contemplated beyond the reach of controversy.

In 1837, in the second session of the Twenty-fourth Congress, the Committee on Roads and Canals had this subject under their consideration and made an elaborate and exhaustive report, exhibiting the utility and feasibility of this important national work, its great commercial and military advantages, and reviewing in a conclusive manner the constitutional questions involved.

In the Twenty-fifth Congress, in 1838, a report from the Committee on Roads and Canals was again submitted to the House, in which they

concur in the frequent recommendations of this project. On the 11th of May, 1858, a favorable report was again made to the Thirty-fifth Congress for the construction of a Niagara ship canal, and granting lands in aid of the project.

A select committee of the Thirty-seventh Congress, which had this subject under consideration, made a report March 3, 1863, at a time when the energies and resources of the country were tested in the fires of a civil war, from which is extracted the following:

In the past, on various occasions, this great enterprise has received great consideration from the Executive, and favorable attention of Congressional committees. It has been pressed upon the attention of the Government by boards of trade, leading commercial men, and State legislatures, and exhibited in all its importance. The bill which will accompany this report will specify as to the dimensions of the proposed work, and ask the amount of money necessary for its construction. We are aware that the energies of the Government are now taxed to the utmost extent to carry on the war, but the tax upon us seems to strengthen and elevate our credit rather than otherwise. Besides, this war will not last always, but we hope will soon be closed. The history of the world can not show an instance like our case. We carry on the greatest struggle the world ever saw within our own resources, and at the same time our credit is fair. Our resources are immense; our patriotism is unfailing, and the confidence of our people in the justness of our cause is beyond a doubt. When this war closes, and the authority of the Government is restored, its honor vindicated, and its authority respected, with our vast resources heretofore unknown, but now discovered, our national prosperity will be unlimited, so to speak, and our people will enjoy a higher life, and rejoice in more complete success than ever before.

As our energies are tried, and we learn our strength and power, we are prepared to make efforts commensurate with that knowledge. These great works of national, military, and commercial importance should not be delayed by any considerations whatever. The efforts put forth in their construction will themselves strengthen and unite our people and make our Union more worthy of our love and protection.

Every road and every canal the Government aids binds our Union together and unites our people, and tends to enrich by developing our resources and bringing out the wealth that lies hidden in the industry and enterprise of our people. The amount asked of the Government is very small, comparatively, and what a work can be accomplished by the expenditure. It is a work of national pride, of military necessity. We owe it to our loyal people of the West and North, largely interested in commercial business upon our great chain of lakes, that every facility for protection be furnished to enable them to carry on successfully and safely their business.

We owe it to ourselves as a nation not to be compelled to make use of foreign enterprise, foreign skill, and foreign public works when we have all the enterprise, skill, and resources within ourselves to provide better facilities than thus employed, while by so doing we would be developing our own resources and benefiting the labor and industry of our own people. The course pursued by our Canadian neighbors during the unfortunate civil war in which we are now engaged, if no other reason existed, should be enough to influence us to action in this direction. Never have a people so utterly failed to be governed by good considerations as they have.

Our legislation, conduct, and actions toward them as a people have all been calculated to bring them under the greatest obligations to us and cause them to treat us as friends and not as enemies. When will America forget the insults and outrages they tried to heap upon us and their efforts to bring us and our cause into contempt? Never, so long as we have any regard for our honor as a people.

Our brave and loyal citizens engaged in service upon our lakes ought not any longer than it will take to construct our own ship canal be compelled to travel theirs in the prosecution of their legitimate business, and Congress and the Government ought to give their early and earnest attention to the construction of the work that is herewith proposed. We demand favorable action, and the committee can but believe that the bill which now proposes to secure the completion of this valuable work will meet with a hearty approval from Congress.

We close this report by using, as expressive of our views, the closing words of the report of Capt. Williams on this subject, as follows:

"If I have shown more interest in the question than is usually looked for at the hands of an engineer, it is that I have felt the strongest conviction of the grandeur, even sublimity, of the enterprise, combined with its general usefulness to the country and the facility of its execution."

The Committee on Naval Affairs of the same Congress, also the same day, reported the same matter favorably.

In 1864 the President of the United States transmitted to Congress the report of Charles B. Stewart, consulting engineer, strongly urging the building of this canal.

It will be found in Executive Document No. 61, Thirty-eighth Congress.

In the Thirty-eighth Congress a bill was introduced authorizing the loan of the bonds of the United States in the sum of $6,000,000 to enable a private corporation to construct a canal a little over 6 miles in length around Niagara Falls, at a depth of 12 feet. This bill met with no opposition, except on the ground that it would make a draft upon the credit of the Government at a time when all its credit was required to raise money to prosecute the war to a successful issue. This bill passed the House of Representatives on the 1st day of February, 1865, by the decisive vote of 95 ayes to 51 nays. Lack of time only prevented its passage through the Senate, as Congress expired thirty days later.

A similar bill passed the House in the Thirty-ninth Congress, May 2, 1866, by 85 yeas and 32 nays.

After this it became evident that a canal of 12 feet depth would not meet the requirements of the increasing lake commerce. Congress on March 22, 1867, passed a joint resolution authorizing a survey to be made. This survey was made on the basis of a depth of 14 feet.

At the third session of the Forty-second Congress the Committee on Commerce reported February 13, 1873, favorably, an act to provide for the speedy construction of a ship canal around the falls of Niagara.

In the first session of the Forty-third Congress, Mr. Windom, from the Select Committee of the Senate, appointed to investigate and report upon the subject of transportation between the interior and the seaboard, submitted a report embodying the views of his committee and accompanied by testimony, maps, and exhibits. That committee devoted most earnest and careful consideration to the subject of the improvement of natural and the construction of artificial water ways. They personally inspected the principal existing and proposed water routes and grouped the leading facts relative to each route under appropriate titles. Their investigations embraced the cost of construction and improvements of such routes; their known or supposed commercial advantages; the cost of transport upon them, and many other facts having an important bearing upon the question of their relative importance as commercial highways.

Among the unanimous recommendations made by that committee was that for the consideration by Congress of the various plans of uniting the lakes with the Hudson River. The committee considered three routes by which the union might be effected, viz:

(1) The enlargement of the Erie Canal from Buffalo to Troy.

(2) The Oneida Lake and Erie Canal from Oswego to Troy.

(3) The St. Lawrence River, Champlain Canal and Lake Champlain.

The national character of the proposed improvements and the benefits anticipated were fully set forth in the report of the committee and the powers of the national Government were discussed with marked learning and ability and most clearly established.

The House Committee on Railways and Canals of the Forty-eighth Congress had under consideration and recommended the passage of a bill to provide for the permanent improvement of the Erie Canal in its report dated March 4, 1884.

The same committee submitted a report February 26, 1886, to the Forty-ninth Congress in favor of a bill providing for the permanent improvement of the Erie and Oswego canals and to secure the freedom of the same to the commerce of the United States.

The river and harbor act of 1888 authorized a new survey for a water way around the Niagara Falls of capacity to float merchant ships and ships of war of modern build drawing 20 feet of water.

Under this provision a survey was made by Capt. Palfrey of two separate routes for a ship canal around Niagara Falls.

The Fifty-first Congress also had this matter under consideration and a favorable report was made to that Congress recommending the immediate entry upon the work of construction of the canal around Niagara Falls and an appropriation of $1,000,000 to be applied to the construction of the canal.

Thus it will be seen that from the earliest history of our Government the necessity of this great work has been fully realized, and yet, except as to that part of the work relating to the survey of the canal around the falls, all conclusions as to feasibility and cost and as to choice of routes and plans have been based upon conjectures, general estimates, and opinions, and nothing has been predicated upon actual surveys and scientific demonstration.

The fact is patent that the interests of Canada and Great Britain on one side and the Eastern and Middle States on the other are diametrically opposed on this very question. The development of the St. Lawrence route, which Canada and Europe both desire, leaves New York as far from the markets of the West as ever, while the manufacturer of Europe is brought almost to their harbors as regards expense of transport.

A route by the way of the Erie Canal or some modification of that route is quite another matter. This would still preserve to the manufacturing East at least a portion of its present advantages as regards position, while the increased demand due to cheapening of transportation on heavy goods would doubtless make up the remainder, with the reasonable assurance of adding to it.

The point is to decide between improving the St. Lawrence canals or the Erie, either on its present lines or a modification of it.

There seems to be but one satisfactory location—by the Erie Canal, or contiguous to it. This leaves the entire route within American borders. It tends to unite the East and West more closely. It reaches the seaboard with very slight loss in distance. It follows the direction of general trade and reaches to its eastern center, New York.

To determine upon its exact location requires a more extended knowledge of the central part of New York State than is now possessed. Only a detailed and carefully planned survey can fully settle the question, but there are several alternatives open. The Erie may be improved throughout its entire length, thus avoiding a canal around Niagra, but this is open to several objections, *i. e.:* The length of actual canal is excessive, involving great expense in construction and maintenance, in water supply and repairs. There is no free river nor lake navigation, and canal speed must be maintained throughout. This means that the trip from Buffalo to Albany would take at least three days and probably four. It leaves Lake Ontario out of the chain of water communication, which omission is to be avoided if it is possible to include it without additional expense.

Next, a modified route may be adopted, via Lake Ontario, the Oswego River, Oneida Lake, and the Mohawk Valley, utilizing the Mokawk River to as great an extent as possible and striking the Hudson at a point at which the proper depth can be maintained. The use of the Oswego and Mohawk rivers and Oneida Lake offer the maximum of free lake and river navigation and the minimum of actual canal;

but the distance which can be canalized (that is, turned into long levels by dams and with lockages) in the Mohawk and Oswego are unknown quantities, likewise whether Oneida Lake can be included at all. In case it can not, it might still be used to great advantage as a reservoir for filling the upper levels of the excavated part of the route, for in the neighborhood of Oneida excavations would have to be resorted to.

It is believed that in view of the immense advantages to the material growth, prosperity, and welfare of our country, the seeming feasibility and the conjectural cost of a deep water way from the lakes to the sea there should be no hesitation or delay on the part of Congress to direct a survey to be made to determine by a scientific demonstration the feasibility and the probable cost of such a canal by the best possible route wholly within our own domain.

This is demanded by the mighty and growing agricultural interests of the vast Northwest; by the wonderful commerce of the Great Lakes and the majestic cities upon their borders; by the millions of consumers of the East, and by that wise and thoughtful statesmanship by which, being at all times prepared for triumph in war, we may at all times maintain an honorable peace.

Appended to this report are various statements, papers, and tables, containing interesting and valuable information and statistics having an important bearing upon the question, and to which attention is invited.

APPENDIX A.

FEBRUARY 1, 1892.

The Committee on Railways and Canals met at 10:30 a. m., Mr. T. C. Catchings, chairman, presiding.

The CHAIRMAN. If the gentlemen of the delegation desire, we will hear them.

Mr. PAYNE. I hope the committee will hear us. I shall now introduce to the committee the delegation from the lower end of Lake Ontario, and also the committee appointed by the Deep Water Ways Convention, recently held in Detroit, to lay before this committee the subject of access of ocean-constructed vessels to the Great Lakes. The project is one of enormous consequence to our people; I may say, so great that it is the paramount one, and concerns the transportation interest of 26,000,000, perhaps I may say 30,000,000, people at the present time.

I don't propose, as I have access to the committee, to go into the question at length, but I will ask the committee to hear in the order which they choose to select two or three of these gentlemen who are here present, giving what time they can spare from their other duties.

The CHAIRMAN. I want to say that the House meets at 12 o'clock; the committee therefore have an hour and ten minutes, which they can divide among themselves.

Mr. PAYNE. I will introduce to the committee Mr. S. A. Thompson, of Duluth.

STATEMENT OF MR. THOMPSON.

Mr. Thompson said:

Mr. Chairman and gentlemen of the committee, Ex-Governor Seymour, of the State of New York, once said, "The chief element in the prosperity of every State and nation is the economy of transportation of persons and property. It is the marked factor in the difference between civilization and barbarism."

The longer I study the matter the more I realize that these words are wholly true in their broadest and deepest sense. Transportation is a tax upon production and consumption. I wish, however, only to draw your attention for a few moments to some facts bearing on the greatest economy of transportation. The wagon way, the railway, and the water way are the three agencies by which transportation is accomplished, the wagon way being essentially local in its character, the railway continental, and the water way worldwide in its spere of action. The wagon way will of course be left out of this question, although I believe the greatest tax on the farmers is the indirect tax which they have to pay by reason of poor roads.

Some ten or twelve years ago two gentlemen, both railway presidents, sat talking together in the office of an Eastern railway. One was president of an Eastern and the other of a Western road. The Eastern man stated that canal boats had been already retired and the river steamers partly driven into disuse by the continually increasing efficiency of railways, owing to the reduction of grades, the lessening of curves, and the building of more powerful engines and larger freight cars, and that it would be but a short time until the steamers of the Great Lakes would also be driven out of use, leaving to the railways an undisputed monopoly.

Standing by themselves the figures showing the reduction of railroad rates are very interesting. The average rate received by all the railroads of the United States in 1882, according to Poor's Manual, was 1.236 cents. According to statistics of the Interstate Commerce Commission for the fiscal year ending June 30, 1890, it was .941 cent. These are microscopic figures, but it means there has been a reduction of almost exactly 24 per cent in nine years.

When we go into the question of comparative reduction of rates we shall see that it is possible to increase the efficiency of steamships as well as of railways. According to a table which I have here and which I will give to the committee, I find that in 1868 the average charge for carrying a bushel of wheat from Chicago to New York, all rail, was 42.6 cents; while in 1885 charge had fallen to 14 cents. That is to say the total cost of carriage had been reduced two-thirds, all rail. It was only one-third as much in 1885 from Chicago to New York as it was in 1868.

During the same time, however, the cost of carrying by the all-water route, that is lakes, Erie Canal, etc., had fallen from 25.3 to 4.55 cents, a reduction of four-fifths in the same period.

Calendar years.	Lake and canal.*	Lake and rail.	All rail.
1868	25.3	29.0	42.6
1869	24.1	25.0	35.1
1870	17.5	22.0	33.3
1871	21.6	25.0	31.0
1872	26.6	28.0	33.5
1873	19.2	26.9	33.2
1874	14.2	16.9	28.7
1875	11.4	14.6	24.1
1876	9.7	11.8	16.5
1877	7.5	15.8	20.3
1878	10.1	11.4	17.7
1879	13.0	13.3	17.3
1880	13.2	15.7	19.7
1881	8.6	10.4	14.4
1882	8.7	10.9	14.6
1883	8.40	11.5	16.5
1884	6.59	9.9	13.2
1885	4.55	9.06	14.0

*Including Buffalo charges and tolls.

Let us return now to another question, getting as near as we can to the actual net cost of transportation, A careful series of experiments on the Grand Trunk Railway showed the actual cost of the movement of freight, exclusive of interest on bonds and dividends on stock, to be 0.5 cent per ton per mile. The average cost as reported to the Interstate Commerce Commission is almost exactly 20 per cent greater than this, while the lowest cost which I have been able to find on record is in the case of the Lake Shore and Michigan Southern, which in favorable years has reported a cost of 0.4 cent per ton per mile.

The average cost on the Erie Canal, according to figures from the State officials, is exactly half as much as that; while on the Aire & Calder Canal, in England, General Manager Bartholomew, who seems to be the greatest genius in canal management which the world has yet produced, reports that he has been able to reduce the cost of transporting minerals to 0.024 cent per ton per mile, and for general merchandise to 0.068 cent, the average being 0.046, and the cost of returning the empties being included in each case.

The figures grow more and more interesting as we go on, and when we turn to the Great Lakes, where we have deeper water, we find results which are almost startling.

Mr. James J. Hill, the Western railway president before mentioned, related some time ago the incident of his conversation with the president of the Eastern railway, and added: "I might have continued to share his belief in the ultimate triumph of the railway over the steamship, if I had not had occasion since that time to build and operate steamships for myself." These steamers carry 2,700 tons of freight on the present depth of water and make the run from Duluth to Buffalo in three and a half days, at an average cost of $120 per day; this is equivalent to 0.015 cent per ton per mile. This means that we are doing to-day on the Great Lakes for $1 what it costs the best railway in the United States $26 to do. In other words, the general conclusion may be deduced from these facts that the larger the carrier and the deeper the water way the less is the cost of transportation.

This same railway president, Mr. Hill, speaking to a convention called in the interest of the water ways, held in a neighboring city of mine some two or three years ago, said; "The engineers of the United States are engaged upon a project by which to give us 20 feet of water through the lakes. We will take the 20 feet of water when it comes and make good use of it; but I will say to you that whenever they will guarantee me 18 feet of water I will build vessels which will carry 6,000 tons instead of 3,000; and I will cut the present cost of water transportation square in two."

Boats now on the lakes which can only carry 2,800 on the present draft of water, could carry 4,800 tons if there were 20 feet of water available, and with no additional expense but a little increase in the coal bill. Referring to the coal question, I will call attention to some facts. I find that on a number of the best vessels of the prevailing type on the lakes the average fuel consumption for 1891 was almost exactly at the rate of 1 ounce of coal per ton per mile, while for some vessels of the "whaleback" type, the new type invented and built at the western end of Lake Superior, I have a statement from the manager of the company recording the con-

sumption of coal for the past year as less than one-third of an ounce per ton per mile.

Another fact which is not generally known is that the best steamships on our lakes maintain a faster average rate of speed per hour than is maintained by any railroad on freight trains. Of course freight trains run about 16 miles an hour while they are running, but they must side track to get out of the way of passenger trains and there are other causes of delay; so that they only get an average rate of speed of 9 miles per hour, while the best modern steamers on the lakes make the run between Chicago and Buffalo at the rate of 16 miles per hour for the whole distance; so we are able to carry goods in less time than is required by the railroads and to do it at one twenty-sixth of the cost.

The effect on railway rates of water competition is exceedingly interesting and important. On roads subject to water competition freight rates invariably go up when navigation closes in the fall and go down again when navigation reopens in the spring.

A study of the statistics in Poor's Manual, or the report of the Interstate Commerce Commission, shows that the lowest rates are found on roads most subject to water competition. Take, for instance the Lake Shore and Michigan Southern, with its average rate of 0.653 cent and the Michigan Central with 0.726 cent per ton per mile, and compare these with the rates on the Chicago, Milwaukee and St. Paul and Chicago and Northwestern roads, which were 1.06 and 1.03 respectively. A multitude of similar facts could be adduced, but the strongest proof of the supreme control exercised by water ways on railway rates is furnished by the railway men themselves. In an argument before the Committee on Commerce of the House of Representatives, made in opposition to the "Reagan bill," in March, 1882, Mr. G. R. Blanchard, the well-known railroad attorney, said:

"The rail-carrying charges upon the great east-bound traffic to the seaboard, for both consumption and export, are, therefore, and must continue to be, limited by natural causes, and can not be beyond or as much as those which, in their absence, would be deemed fair and reasonable, and are always below the rates for like distances, articles and speed by rail anywhere in the world. So potent are these facts that it is within the power of, and is often the case that the combination or independent action of, a few sail vessels at Chicago can, in their seasons of navigation, procure rates from owners of an equal capacity of Erie canal boats from Buffalo to New York, which added to their own rates to Buffalo and transfer charges will fix, and have in actual practice fixed and regulated, the entire eastward through maximum rail freight charges for a time upon all kinds of grain and many other articles. * * * Can any safer limitation or check be legislated than the inflexible limitations nature enforces in its uncontrollable rivalry? * * * The application of water results are inexorable in their effects upon railroad rates within periods ranging from seven to eight months in each calendar year and usually all the year in rivalry with western rivers. * * * In view of all these facts, I now say, with Mr. Fink: 'Compared with this powerful regulator of railroad transportation tariffs, the efforts of State or Congressional legislation to prevent extortionate charges appear to those at all conversant with the subject as perfectly useless.'" To such a statement from such a source nothing need be added.

FAR REACHING INFLUENCE OF WATER WAYS.

It should be noted also that the influence of water competition is not confined to the roads which run close along the water ways. The New York Central and Lake Shore and Michigan roads, considered as one, are paralleled by a water way the entire distance from New York to Chicago, and rates are necessarily made under the influence of that competition. The Pennsylvania Central, lying perhaps 150 miles further south, can make no higher rates than the New York Central, otherwise the latter road would get all the business. On that point we have the testimony of a great many railroad men.

Mr. Albert Fink, the railroad commissioner, used the following words in 1878, in a letter addressed to Hon. William Windom, who was at that time chairman of the Senate Committee on Transportation Routes to the Seaboard:

"You are aware that when the rates are reduced between Chicago and New York on account of the opening of the canal, this reduction applies not only to Chicago, but to all interior cities (St. Louis, Indianapolis, Cincinnati) to New York. If that was not the rule the result would be that the roads running, say, from St. Louis, Indianapolis, and Cincinnati to Chicago, would carry the freight to Chicago, from which point low rates would take it to the East, and leave the direct road from the interior points to the seaboard without business. Hence, whenever the rates are reduced on account of the opening of navigation from Chicago and lake ports, the same reduction is made to all interior cities, not only to New York, where the canal runs, but to Philadelphia and Baltimore. Although the latter cities have no direct water-route

communication with the West, yet they receive the benefit, as far as railroad rates are concerned, the same as if a canal were running from the lakes direct to these cities, because whenever rates from Chicago to New York are reduced it is necessary to reduce the rates from Chicago to Boston, Philadelphia, and Baltimore; otherwise the business would all go to New York. The reduction of the rates from Chicago and St. Louis to Baltimore causes a reduction in rates on shipments via Baltimore to Atlantic ports—Norfolk, Wilmington, Savannah, Brunswick, and Fernandina—and from there into the interior of the Gulf States—Augusta, Atlanta, Macon, Montgomery, Selma, etc. * * * These roads * * * are obliged to follow the reductions made via the Baltimore road, and which were primarily made on account of the existence of the Erie Canal and the opening of navigation. The same way in regard to the west-bound business * * * so that it may be said that the rail rates are kept in check by water transportation."

Nor is water competition confined in its effect entirely to the season of navigation. The same authority last quoted testified before the Senate Committee on Interstate Commerce that at least, so far as grain rates are concerned, that influence extends throughout the winter. "For," said he, "if the rail rates are made too high, the grain is simply stored to await the drop in rates which is certain to come when navigation is opened."

INFLUENCE ON INTERIOR RAILWAYS.

It is wonderful to see in how many directions and to what a distance the influence of the water way extends. We have seen that it not only gives the cheapest form of transportation, but that it exerts a powerful influence on the railways which parallel the water route, whether close by or hundreds of miles away, and that this influence is felt even during the time when the water way is frozen up. And even this is not all. The beneficial effect of the water way extends also to the interior of the country, which is reached only by railway lines which terminate upon the water way and make a through line for the transportation of freight in connection therewith.

An illustration occurs to me: Rates on coal from the East are lower to Duluth than they are to Chicago, owing to circumstances into the details of which I do not care now to go, but because of this fact Duluth dealers have been able to sell coal as far south as Kansas City and to many other points which are much nearer to Chicago than they are to Duluth, and the cost of getting freight from New York to points in Montana, Kansas, Colorado, and the West generally is a great deal less than it would be if the Great Lakes were not where they are. As a further illustration of this fact, take the case of Aberdeen, Watertown, Huron, and other towns in South Dakota, where on the day they gained railroad connection with Lake Superior wheat went up 7 cents a bushel, and coal came down $2 a ton.

Just a word as to the immense traffic built up on the lakes. In 1889, according to the estimate of Hon. George H. Ely, of Cleveland, there passed through the Detroit River, representing the commerce of all the Great Lakes except Ontario, a little over 36,000,000 tons of freight. In the same year the total tonnage, both coast and foreign entries and clearances, of every sea port in the United States—Atlantic, Gulf, and Pacific—was a little less than 26,000,000 tons; while the combined tonnage of Liverpool and London, both coastwise and foreign entries and clearances, was less than the tonnage of the lakes by 3,000,000 tons. It seems to me, gentlemen, that a traffic of such dimensions is entitled to a great deal of consideration at the hands of Congress. The traffic which was carried on the Great Lakes during the year just closed has been very accurately figured out, and we find that if this traffic, which was carried on the lakes last year at an average cost of about 1.1 mills per ton per mile, had been carried an equal distance by railway it would have cost $150,000,000 more than was paid for its carriage by water. And as the total expenditure on all the lakes above Niagara Falls, under all the river and harbor bills on all lake and harbor improvements, has been less than $30,000,000, it follows that the saving to the business interests of this country in one year has returned fivefold and more the total expenditure during all the years of the past.

Now, we are here to ask at the present time, not merely this committee, but all members of Congress, to consider that, by a total expenditure of $3,394,000, according to the estimate made by Gen. O. M. Poe, we can be given through all the connecting channels of the lakes above Niagara Falls a channel 20 feet in depth. As I have pointed out to you, the saving which would come to us from this added depth will make a greater reduction in the cost of transportation annually than the expenditure of the $30,000,000 which has already been made. We therefore ask you to consider carefully the request which has been made by this convention. We ask you to consider the facts that have been presented, and that you will, by giving us this comparatively small appropriation, realize these benefits for us.

He who can most cheaply reach the markets of the world can control the markets of the world. That is an axiom to my mind. One or two lessons from foreign lands are interesting. The first canal was built in France one hundred years before Christ, and

they have been building canals ever since. If our state of Texas could be made into a circular sea and France made into a circular island there would be a strip of ocean 100 miles wide all around France, and yet that little country since 1814 has spent more than $650,000,000 on canals, rivers and harbors, over $700,000,000 more on railways, and I do not know how many hundreds of millions upon her wagon roads. During the terrible stress of the war with Germany they still kept building canals; and after the drain of that war and all that enormous war indemnity, in the seven years from 1870 to 1878 they spent 28,000,000 of francs on canals alone. As an indication of the widespread public appreciation of the advantage which canals and water ways are to that country, recently a plebiscite was taken to ascertain the popular feeling as to the question of constructing a ship canal, 114 miles long and 21 feet deep, from Paris to Rouen; out of 345,000 votes received there were just 13 against the measure.

It seems to me that the ease with which France recovered from the terrible drain of the war with Germany was because of the fact that they have an absolutely incomparable system of transportation facilities by wagon, railway, and water. There is nothing that is like it in completeness in the world.

Turn again to a country somewhat nearer home. Our little neighbor Canada, with a population no greater than that of New York State, has expended $60,000,000 upon her water ways. That has a bearing upon something which I think has not yet been generally realized. This country is a great producer of grain and breadstuff, and so far we have managed fairly well to hold our own. To my my mind one of the great causes of agricultural depression was the building of the Suez Canal, because that brought into competition with our people, by a direct water route, the cheap labor of India at 7 or 8 cents per day. But a competition is coming in the near future such as our people have never faced. I find that a parallelogram can be taken in the Canadian Northwest equivalent in size and productiveness to a parallelogram in Europe which would include the most of Germany and Russia, France, Holland and Belgium, Sweden and Norway, and Great Britain and Ireland.

We think that we in Minnesota know what fine wheat is. Minnesota and the two Dakotas raised 150,000,000 bushels of wheat this past year, and yet we never saw such wheat or dreamed of wheat of such quality before until we saw the wheat that came from the Peace River Valley, 1,500 miles northwestward from the far northwestern city of Duluth, in latitude 59° north and longitude 111° west. It is raised there every year. It is not a question of doubt, it is done every year regularly. Inside of five years, at the present rate of progress, there will be a clear water way through Canadian Territory of 14 feet in depth all the way from Lake Superior to the ocean. Gentlemen, when that time comes I say to you that 6 feet of water through the Erie Canal with a transshipment at each end can no more compete with 14 feet of water through the Canadian canals with no transshipment at all than a wheelbarrow can compete with a freight train.

What does it mean? It means that all the breadstuffs for direct exportation coming from that great region tributary to the Great Lakes will be carried by Canadian instead of American vessels. They have the privilege of touching at one American port on each trip, and if they can carry, as I believe they can, the grain at a cost of 10 cents per bushel from the head of Lake Superior to Liverpool, while it costs 25 cents by way of the Erie Canal and New York State, I am afraid there is not sentiment enough in trade to influence people to pay the double price.

We have held our own fairly well in competition with the cheap labor of India; but when we come to compete with men of our own race, with a climate no more rigorous, with a soil just as productive, and with transportation facilities immeasurably superior, the farmers of Kansas and Nebraska and the rest of our Western States are going to have an agricultural depression such as they never knew before, unless our own nation shall give us a way to the sea, so that our ships can go and come as freely as they do on the ocean. And we want a 21-foot channel, whereas they will have one but 14 feet deep.

Then there comes still another matter. I have been at Quebec. The old citadel there, of course, is of no use as against modern artillery; but on the other side of the river are fortifications of a modern type. I don't want to undertake to force a way by them. Halifax has been made as impregnable as Gibraltar. The Bermudas have been fortified so that they also are as impregnable as Gibraltar, and there is a dry dock there capable of lifting any war vessel in the British navy; at Kingston there is another fortification, a depot of naval and military supplies, and another great dry dock; again, St. Lucia, in the West Indies, is being fortified; so that they have drawn around our entire Atlantic coast a cordon of military and naval stations, and have connected them with a cable. These are supplemented on the Pacific by a magnificent naval and military depot at Esquimault; so that in an hour, on receipt of a telegram from London, they could launch a fleet from Halifax against Boston, New York, and Philadelphia; from the Bermudas against Charleston and Savannah, and from Kingston against the ports on the Gulf; while if the Panama Canal or the Nicaurauga Canal are ever completed, there is a fortified post with British guns

pointing directly into the mouths of those highways of commerce, and these posts are held in time of peace by 10,000 British regulars and guarded by sixteen of the best war vessels in the world.

In the report of the House Military Committee, published in 1862, I find these words:

"The United States and Great Britain are equally prohibited by treaty stipulations from building or keeping afloat a fleet of war vessels upon the lakes. At the same time, on the shores of these lakes the United States have many wealthy cities and towns, and upon their waters an immense commerce; these are unprotected by any defenses worthy of special notice, but are as open to incursion as was Mexico when invaded by Cortez. A small fleet of light draft, heavily armored gunboats could, in one month, despite of any opposition that could be made by extemporized batteries, pass up the St. Lawrence and shell every town and city from Ogdensburg to Chicago. At one blow it could sweep our commerce from that entire chain of waters. To be able to strike a blow so effective, Great Britain constructed a canal around the falls of Niagara. By this single stroke the entire chain of lakes was opened to all British light-draft ocean vessels. Perceiving our ability to erect works upon the St. Lawrence that might command its channel and thus neutralize all they had done, Great Britain dug a canal from the foot of Lake Ontario on a line parallel to the river, but beyond the reach of American guns, to a point on the St. Lawrence below, beyond American jurisdiction, thus securing a channel to and from the lakes out of our reach. Occupied by our vast commercial enterprises and by violent party conflicts, our people failed to notice at the time that the safety of our entire northern frontier has been destroyed by the digging of two short canals. Near the head of the St. Lawrence, the British, to complete their supremacy on the lakes, have built a large naval depot for the construction and repair of vessels, and a very strong fort to protect the depot and the outlets of the lake, a fort which can not be reduced—it is supposed by them—except by regular approaches.

"The result of all this is that in the absence of ships of war on the lakes, and of means to convey them there from the ocean, the United States, upon the breaking out of war, would, without navy-yards and suitable docks, have to commence the building of a fleet upon Lake Ontario and another upon the upper lakes. At the same time, England, possessing a naval depot at the entrance to this system of waters, can forestall us in all our attempts, both offensive and defensive.

THE COLOSSAL PRIZE AT STAKE.

It is not necessary to call your attention to the enormous increase in the size and importance of the cities upon the lakes, and in the extent of the commerce carried upon these waters since these words were penned, nearly thirty years ago. It is a shame and a disgrace to this great nation that this commerce and these cities are just as defenseless to-day as they were then. In the report of the Board of Fortification published in 1886, I find a list of one hundred and eleven vessels in the British navy drawing 12 feet or less. How many more there are that draw 14 feet or less, I do not know.

Gentlemen, within three, or at the most five years from the present time, it will be possible, according to the best information I can get, for more than one hundred and fifty vessels of the British Navy to pass through Canadian canals situated in Canadian territory into the waters of the Great Lakes, which they have the same right to navigate that we have.

Q. Couldn't we seize the Welland Canal and stop their passage?—A. Yes, if they did not start until after war was declared. But you will remember that when there was a prospect of trouble with Chili we did not wait until war was declared, but sent every available cruiser steaming southward as fast as it could go, so that it might be in a position for use if it should be needed. The treaty at present in force by which both nations are prohibited from building or keeping afloat a fleet of war vessels upon the lakes can be abrogated by either nation on six months' notice. Suppose Great Britian gives the necessary six months' notice and abrogates that treaty. She is a sovereign nation and has an undoubted right to do so, and when it is done they can introduce their war vessels into the Great Lakes, and have at their mercy not only the magnificent commerce of the lakes, which I have briefly described to you, but also every city from Ogdensburg and Oswego to Chicago and Duluth, whenever they choose to declare war, unless this nation is prepared to take and maintain the position that, treaty or no treaty, the passage of a single British gunboat through the Welland Canal is to be considered as an act of war.

Commercially considered, a water way from the lakes to the sea would be worth a hundred-fold its cost, although that cost will necessarily be large; but considered from a military point of view, it seems to me that this great nation can no longer afford to leave the commerce and the cities of our northern lakes in their present defenseless condition. We have not a fort or a gun worthy of the name on all the chain of lakes, and no possible way to put into the lakes a single vessel, of war while

the other nation owning the territory on the north can put her whole navy armament with the exception of a few vessels into these lakes, and have our cities and our commerce absolutely at their mercy unless we prepare some way in which to meet them.

Turning now from the general question, I wish to give you a few of the reasons why we ask that some one of the pending bills providing for a ship canal around Niagara Falls should be passed and the construction of a water way from Lake Ontario to the Hudson should be undertaken. One suggestive fact is, that in consequence of the great wheat crop of the past year there were at one time last fall between ninety and one hundred vessels lying at Buffalo and in danger of freezing up in the outer harbor because they could not get to an elevator. All the facilities available were utterly inadequate to take care of the flood of grain poured in upon them from the West. If we had a canal around Niagara Falls, the branch of the Erie Canal at Oswego would be equally available as at Buffalo, also the six or seven railroads which would come into competition with those terminating at Buffalo; and those vessels, instead of lying perforce at the end of Lake Erie, would have gone down to Oswego and had their cargoes satisfactorily and cheaply cared for.

Q. Has there been a survey and estimate made of the cost of the work around Niagara Falls?—A. I understand that there has. There have been some surveys made in the past, a number of them, but not on the basis of what we call a ship canal. Capt. Kingman, of the Engineer Corps, is present this morning, and he can answer these questions. Estimates have been made, as I understand, for a canal 12 feet in depth; but the whole West would protest against the building of a canal around Niagara Falls unless it is made at least 20 feet in depth.

The advantages in the way of competition of the Niagara Ship Canal have been mentioned, but I believe further that Lake Ontario should be brought into connection with the other lakes. It is a simple matter of justice to the people lying on the borders of that lake. Why should it remain permanently cut off from the other lakes any more than our own great lake of Superior should have remained so by the falls at the Saulte de Ste. Marie.

Then another reason why, in my judgment, this route around Niagara Falls is the best: I find that in looking over the possible routes that by this one we have the great advantage of 110 miles of open navigation in Lake Ontario. Progress through a canal probably is only from 4 to 5 miles an hour—under exceptionally favorable conditions they go 7 miles an hour—while our vessels steam 14, 15, and 16 miles an hour in the open lakes. Through Oneida Lake there will be the same advantage of deep water; and when we come to the Mohawk we will canalize that river as they have done on the Rhine and the Main, and there, with natural banks of the river and the deep channel in the center, boats can go as rapidly as they desire, and it will be of the utmost advantage in that particular. Then another reason for the route by the way of Niagara Falls and through Oneida Lake and Oneida River: This is the only route that can be found on the map which does not involve the crossing of numerous streams. You will notice that we go with the streams, instead of crossing them and involving enormous expense and difficult structures.

I have spoken to you, gentlemen, so far, rather disjointedly, but to sum up in a word what has been shown by experience, the cost of transportation by water is far less than the cost of transportation by rail; and by giving us deeper water for larger vessels the cost will be still further reduced. As a proof of the influence of the canal on railway rates I will say that as long as the Erie Canal was open the railroads were carrying grain at 3½ cents a bushel —less than cost— but immediately the season closed the rate jumped up to 7½ cents; that is one benefit of competition. We in the Northwest want to be put in the same position with any part of the nation and at all seasons of the year. The people of the West want to get their products shipped just as cheaply as any part of the nation.

Then, among other advantages, there are $63,000,000 worth of vessel property on the lakes, the value of which, if a water way was opened out to the ocean, would be almost doubled instantly; because instead of tying up at docks and in our lakes they would pass out to the ocean and engage in ocean traffic during the winter, and the earning capacity of the vessels would thus be doubled.

Q. What is the depth of water in the Hudson?—A. From Albany to Coxsackie, I understand, they have 11 feet of water. An estimate has been recently made that to deepen the channel to 22 feet, so as to make an available 21 feet of navigation from Coxsackie up to Albany, would cost over $5,000,000. This estimate I am inclined to consider much too high; because the cost of rock work is set down as $10 per cubic yard, while similar work has been done in other places as low as $1.20 per cubic yard.

Q. How is the depth of water from there to New York?—A. I understand there is some 20 feet of water from there to New York, so that a very small expense will give us an available depth of 20 feet to Albany.

Now, gentlemen, I shall not trouble you any further. I thank you for your courtesy in listening to me so long; but it seems to me that in the light of the figures I

have given here and in the light of the military advantage and the commercial advantage, this Niagara Ship Canal should be constructed. It will be the great through route to the ocean which we must have if we are to hold our own with the rest of the world.

You will pardon me for just one more word which has occurred to me. I do not desire to be in the least understood as opposed to railroads. Demonstrated facts prove that instead of being a disadvantage it is a great advantage to a railroad to have a water way alongside. I thoroughly believe that the best thing that could happen to every railroad in this country would be to have a ship canal paralleling every mile of its track. In 1886 the river Main was canalized from Mayence to Frankfort. In 1887 the business of the river increased 64 per cent, and in 1888 42 per cent, above the figure of 1886, while the business of the two railways lying on either side of the river increased 36 in 1887 and 58 per cent in 1888. The business of the city was enormously increased. Previous to that time Frankfort had practically nothing to sell and everything to buy, while, following the cheap freights made possible by the improvement in the river, manufacturing industries were so stimulated that traffic from the city was equal in volume to traffic towards the city. Taking an illustration nearer home, look at the New York Central Railway, running for hundreds of miles on the very banks of a water way, and subject to water-way competition for its local as well as its through traffic, yet there is no better dividend-paying road in the United States and no other which has been compelled to build four tracks to accommodate its business.

Mr. PAYNE. I will now introduce Capt. Kingman to the committee.

The CHAIRMAN. This is Capt. Kingman, of the Corps of Engineers, now stationed at Oswego, on Lake Ontario.

Capt. KINGMAN. Do you wish me to answer questions, or shall I proceed to discuss such matters relating to the subject under consideration as I think may be of interest and importance?

The CHAIRMAN. Proceed in your own way, Capt. Kingman; some of us, at least, have listened to you before upon other subjects.

STATEMENT OF CAPT. KINGMAN.

Capt. Kingman said:

In speaking of a deep-water route from the Great Lakes to tide water I shall confine myself to the engineering considerations alone. The public importance and commercial value of such a route have already been fully set forth. I regret very much, however, that I find myself at the outset forced in many cases to limit myself to stating what I *think*, instead of being able to declare positively what I *know*. This is due to the absence of that exact knowledge of all of the difficulties to be met and overcome which can only be obtained by a complete and exhaustive examination and survey of all of the possible routes. A survey, too, made with reference to securing just such a route in depth and capacity as we now propose to secure. And no such survey has ever been made. I am referring only to that portion of the route that lies between Lake Erie and Albany, on the Hudson.

In 1867 Col. Blunt, of the Corps of Engineers, made a survey of a number of routes for a canal around the falls of Niagara to connect lakes Erie and Ontario. The canal proposed was 90 feet wide at the bottom and 14 feet deep. The locks were to be 275 feet long, 46 feet wide, and having a lift of about 15 feet each. Six different routes were examined and estimated upon. There was little difference in their cost, it being about $13,000,000 in each case. The report does not indicate a preference for any one of these routes.

Twenty-one years later, in 1888, the needs of commerce having long since outgrown the project of Col. Blunt, another examination was ordered by Congress with a view to ascertain the cost of a canal equal to modern requirements. The results of this investigation are to be found in the report of the Chief of Engineers for 1889.

It does not appear from this report that a new survey was made or that any additional information as to the difficulties to be overcome was gathered. Under authority contained in the act ordering the survey, the information obtained by Col. Blunt in 1867 was permitted to be used, and was used as a basis of estimate.

In the 1889 report, estimates are given for but two routes, and a preference is indicated for a route starting at Tonawanda, on the Niagara River, and terminating on Lake Ontario, at Olcott, about 18 miles east of the mouth of the Niagara River. This route certainly seems to possess decided advantage over any of the others proposed.

The new plan contemplated a canal 100 feet wide at the bottom, 150 feet at the water surface, and 20½ feet deep, having locks 400 feet long and 80 feet wide with a lift of 18 feet. The estimated cost of this work was $23,617,900.

I can not help thinking that this estimate is large. For example, the unit price assumed for rockwork is $1.25 a cubic yard. This is the same as was used in the es-

timates of 1867. If the work could have been done at this price in 1867, and there seems to be no good reason to doubt it, then the latter estimate ignores all the advantages resulting from the improvements of twenty-one years in the methods of handling rock, due to the use of high explosive compounds, electric fuses, and power drills.

The rock along the line of the canal is not very hard, and it will not be necessary to work it under water. It does not seem unreasonable, therefore, to expect that a material reduction might be made in this item of the estimates.

The unit price for earth was 25 cents a cubic yard—also the same as was estimated twenty-one years before. This would seem to ignore all of the increased facilities for handling earth resulting from the general employment of steam excavators and conveyors.

The estimated cost of the locks was based upon that of the lock at the Saint Marys Falls Canal, allowance being made for the difference in size. This ought to be an accurate method, other things being equal. But it must not be forgotten that this lock begun in 1870 and was thirteen years under construction; that it presented many difficulties that were new then, but which we now know, as the result of experience, exactly how to meet. I do not think that the builder of that lock would hesitate to undertake to duplicate it for a good deal less than it cost.

Again, there seems to be no good reason why the lift should be limited to 18 feet, which requires eighteen locks and a guard lock, to be used to overcome the difference of level between the lakes. It would certainly tend to expedite transit through the canal if the number of locks were reduced to a minimum.

If the lift was increased to about 25 feet the number of locks could be reduced to thirteen; and if it was increased to about 32 feet, the number could be reduced to ten.

Of course a deep lock would cost more than one with a small lift, but between a great many shallow locks and a few deep ones there would be found a number which would give the most economical and advantageous result. I can not tell now exactly what the number would be, but I am inclined to the opinion that twelve or thirteen locks would be the proper number.

This reduction in the number of locks would doubtless reduce the amount required for lock construction. Finally, more than $2,000,000 was included in the estimate for "contingencies."

Taking all things into consideration, it seems not unreasonable to expect that this canal could be built to-day for a sum materially less than that named in the report.

But it is by no means certain that the canal would in all respects meet the present requirements, so great has been the increase in the size of our lake vessels in the last few years. In fact, it seems certain that the length of lock proposed, 400 feet, would be insufficient to admit some of the vessels that will be afloat on the upper lakes before this canal could possibly be completed. Therefore I think estimate should be made for locks not less than 500 feet long.

On the other hand, a bottom width for the canal of 100 feet may perhaps be found unnecessarily large. The Suez Canal is only 72 feet wide at the bottom, and it has been stated that it is very fortunate that it was not made any wider, as vessels steer better and are more easily controlled in it than they would be in a wider one.

In this canal vessels do not attempt to pass each other wherever they may happen to meet, but wide places, called gares, are provided at suitable intervals, and the meeting of vessels is arranged in the same manner as that of trains on a single track. The one having the right of way keeps on its course, while the other enters the gare or siding and is secured to the bank. It is thought that this way is safer, better, and more expeditious in the long run than it would be to let large vessels pass each other at will in a canal of any width that it would be practicable to build.

If this theory is sound, then it might be possible to save one-fourth of the excavation proposed in the Niagara Canal by reducing the bottom width from 100 to 75 feet. The surface width I think should be greatly increased where the cut is in earth. Instead of 150 feet I would make it at least 300 feet; and I would make the side slopes from the water surface down to a depth of 6 or 7 feet very flat, like the natural shores of a lake or pond, and from this depth to the bottom of the canal I would make the slopes as steep as the material will safely stand, say about 1 on 2.

The upper flat slopes would be protected by a riprap or pavement. The lower slopes would be left of earth, so that a vessel would not be injured if it happened to strike them. This form of canal would give the wave raised by the vessel a chance to spread and break on the flat slopes as on the beach, would afford space for the water to flow round the vessel, and ought to reduce the resistance due to passing through a narrow channel to a minimum.

So much for the Niagara Canal. And now after getting vessels down into Lake Ontario, it is necessary to provide a way for them to pass from it to tide water in the Hudson River, say at Albany.

The best route for this purpose seems to be via the Oswego River to the mouth of

the Oneida River, then up this river to Oneida Lake, thence across the lake and over the divide to the Mohawk River near Rome, thence down the Mohawk to the Hudson. We have not as good information as to the cost of a ship canal via this route as we had in the case of the Niagara Canal.

The present Erie Canal affords a route along this line for vessels drawing something less than 7 feet. In 1874, Col. Wilson, Corps of Engineers, made a survey of this route and prepared estimates for a canal 120 feet at the bottom and 10 feet deep, having locks 185 feet long, 29 feet wide, and with 9 feet of water on the miter sills. The locks to have an average lift of about 9 feet. The estimated cost of such a canal was $25,000,000.

Of course this was not a ship canal at all. It was intended for the use of steam barges or canal boats capable of carrying 28,000 bushels of wheat. And it falls so far short of what we now desire that it is of very little value as a means of determining what a ship canal would cost.

We can, however, form a rough estimate of the probable cost in this way: Taking the estimate for the Niagara Canal as a basis (and from what I have already stated about it we shall be likely to err on the side of safety), we find that the total amount of lockage on the Mohawk Canal is 610 feet, being nearly double that on the Niagara Canal. On the latter the estimate for locks was $10,000,000, therefore the locks from Lake Ontario to Albany should cost double the sum, or $20,000,000.

The distance (leaving out the length of Oneida Lake) is about seven times as great as the length of the Niagara Canal. The estimated cost of excavation on the Niagara Canal was $10,000,000, therefore, other things being equal, the excavation of the Mohawk Canal ought to be seven times as great, or $70,000,000. This would make the total cost about $90,000,000.

I am satisfied that this is too large, because with exception of a short distance between Oneida Lake and the Mohawk River this route really would not be a canal at all, but would consist of three canalized rivers, namely, the Oswego, the Oneida, and the Mohawk. And as the existing channels of these rivers would be utilized to the fullest extent, the amount of excavation would certainly thereby be greatly reduced.

In this rough way, however, you can form some idea what the cost would be.

The principle objection which is always raised to this Mohawk Valley route is the want of a sufficient supply of water for the summit level. They have considerable trouble now in periods of protracted drought in obtaining sufficient water for the present Erie Canal with its seven-foot depth. And the opponents of this route ask, with apparent reason, "How are you going to obtain water for a canal of five times the capacity of the present one?"

The present water supply is drawn from the Black River, a tributary of the St. Lawrence, and from certain reservoirs in the Adirondack region. It is stated in many of the reports upon the subject that the present reservoirs are not utilized to the best advantage, and that many others might be built which would enormously increase the supply. But if this source should prove inadequate we have an inexhaustible supply in Lake Erie.

The level of the water in Lake Erie is about 150 feet above the summit level of the canal at Rome, and there are no insurmountable obstacles in the way of conducting this water in any desired quantity to the Rome level by the construction of an open feeder similar to the large irrigating ditches now under construction or in use in some of the Western States.

Such a feeder might leave the Niagara Ship Canal at Lockport, at which point the water would be very nearly at Lake Erie level; it could then either be carried by a route entirely separate and distinct from that followed by the Erie Canal to the Rome level, or else a portion of the present Erie Canal might be utilized.

The water from Lake Erie is now carried in the Erie Canal as far as Montezuma, a point where the canal crosses the Seneca River. This point is below the Rome level, and of course the water can not now be utilized beyond this point. If the Erie Canal was used at all it would be necessary to depart from it in the vicinity of Rochester, and maintain a higher grade, in order to carry the water over the present low portion.

A different crossing over the Montezuma marshes would undoubtedly have to be selected, and the water carried across this low ground either by means of a viaduct similiar to those used in the West, or possibly by an inverted syphon.

It might be asked, if all this work is to be done in order to bring water from Lake Erie, why would it not be better to make this feeder a little larger and use it as a ship canal? The answer would be, that in the case of a feeder which is not to be navigated, we should be able to resort to tunnels, inverted syphons, and other similar devices when necessary to carry the water over and through obstructions, and we should not be so restricted in the matter of alignment as in a navigable canal. For these reasons a feeder which would be ample for the purpose could no doubt be constructed for a very small fraction of the cost of a navigable canal.

Finally, the great advantage which this route—that is to say, the route by the Niagara Ship Canal, Lake Ontario and the Oswego, Oneida Lake and Mohawk River,

offers over any other route which can be selected, is this, that it does not cross any natural water course. For a canal only 6 or 8 feet in depth, it is not a very difficult matter to cross a river by means of an adequate bridge, but when it is a question of a canal which is to be 20 feet deep, the difficulty is enormously increased. In the first place the weight of water to be carried, which would be more than 1,200 pounds to the square foot of surface, would require very heavy and massive structures. Moreover, it would be very difficult and would impose many hard conditions to bring a canal to a river in such a way as to enable us to hold its surface more than 20 feet above the level of high water in the river.

In the case of small streams which a canal intersects, three things can be done either the stream can be carried under the canal in a culvert, or else it can be carried over the canal by a bridge, or else it can be admitted into the canal as a feeder.

The first method is the one generally used in canals of moderate depth, but it would be very difficult and expensive to apply it in the case of a canal that was 20 feet deep as it would generally involve a lowering of the bed of the stream for a considerable distance on each side of the canal, or else the use of an inverted siphon, which would be a very unwise expedient as it would be liable to be choked up by sediment and thus dam the stream.

To carry the small stream over so large a canal would also be very difficult, and would require the use of a drawbridge in order to allow the passage of vessels in the canal, therefore to admit the small streams into the canal would be almost the only practicable expedient, and this would be objectionable and often dangerous, because of the large amount of water and solid material that might be delivered in time of freshets.

One of the most serious obstacles that the Panama Canal had to encounter was the Chagres River, which it intersected a number of times in its course, and which formed an obstacle for which no very satisfactory remedy was ever found.

The canal from Oswego to Albany, would be situated in the beds of existing streams. It would take the line of the natural drainage of the country.

It would therefore receive in a natural way, as feeders, all of the tributary streams, and would be likely to suffer the least possible loss from seepage.

Q. What would be the total cost of this project?—A. According to the rough estimates which I have given, it would be about $20,000,000 for the Niagara Ship Canal and $90,000,000 for the canal from Oswego to Albany. In all, $110,000,000.

Q. That would be on the presumption that the Government would supply the money as rapidly as possible?—A. Yes. It would be on the supposition that no injurious or expensive delay should result from the failure of appropriations; in other words, it is on the supposition that the money should all be appropriated at once, or that provision should be made by law for awarding contracts for the whole work, to be done and paid for as money was appropriated.

Q. How long would it take to complete this project?—A. It would take at least three or four years.

Q. You would want, then, about $25,000,000 or $30,000,000 a year, or as large an amount as the appropriation for all the river and harbor improvements of the whole country?—A. Yes, if it was intended to push the work as fast as possible, but it would not in any case be necessary to have as much as this for the first year.

Q. When we appropriate $23,000,000 for all the rivers and canals in the country, we are very much abused?—A. Not by those who fully understand the value and necessity of these works.

Q. Would you utilize the old Erie Canal from Syracuse down?—A. I do not think that the location of the present Erie Canal would be the most favorable one. I think the route would follow the channels of the Oswego and Oneida River, and would then pass through Oneida Lake, and leave it so as to strike the Mohawk by the shortest possible line, and would then follow the channel of the Mohawk.

Q. You would not touch the Erie Canal at all?—A. No, sir; we would go back to the old canoe and bateau trail used by the Indians, a route that was mentioned as worthy of improvement by the surveyor-general of New York as early as 1724.

Q. I understand a survey has been made below Albany as an independent project?—A. A board was appointed to consider that subject in consequence of a section in the last River and Harbor bill. What results they arrived at I do not know. It was of course quite independent of the ship canal project. It was a link, however, in the chain, and would be of immediate advantage in bringing ocean navigation that much nearer to the lakes.

Q. In your opinion, does the value and importance of the project demand the expenditure necessary for a close survey and estimate to determine the actual feasibility of a water way from the lakes to the Hudson?—A. Yes, sir; it is certainly a project of great promise, and it has never had a thorough survey. We had a survey made from Oswego to Albany for a 9-foot canal; but that was a very small affair. According to the surveys and estimates then made such a canal could be built for $25,000,000.

Q. Do you know what the cost of the Erie Canal was?—A. I think the total cost was about $50,000,000, of which the enlargement cost about $42,000,000.

Q. What would be the cost of a thorough survey?—A. If the survey was limited to this one line, which I have described, that is to say, from Tonawanda to Olcott, and from Oswego via Oneida Lake to Albany, a thorough and satisfactory survey might be made for $35,000 or $40,000. If it was necessary to consider the construction of a canal on some other route or routes from Lake Erie to tide water, then, of course, the cost would be a great deal more.

Q. How much would it cost to make a survey of a route from Oswego to the Hudson?—A. For this part of the route about $25,000 if made for a single route, but if it was going to be a general survey, and a good many other routes were to be considered, requiring a number of surveys, then, in that case, $100,000 might not be too much. However, if you limit it to the route which I believe to be the best and only feasible one, then the smaller sum, that is, $40,000 would be amply sufficient.

Q. Don't you think it would be necessary to consider all the available routes in order to stifle criticism?—A. From this point of view, as matter of policy, they ought all to be considered, of course, because every route has its own advocates and friends who know its advantages and who would advance the best of reasons in favor of their own particular route, and in order to satisfy everybody I think every route should be examined and thoroughly considered.

Q. Do you deem it feasible to adopt the Champlain route, and have a communicating waterway on our own territory?—A. I think that would be impossible.

Q. In your judgment is it likely that a sufficient water supply could be obtained in the Adirondack region and Black River for the purpose of this canal from Oswego to the Hudson?—A. It is possible that a sufficient supply might be so obtained. This subject would be fully investigated and it might not be necessary to draw water from Lake Erie at all. I do not think that the canal proposed would require as much water in proportion to its size as the present Erie Canal. A very considerable portion of the water required to supply any canal goes to make up the loss from leakage. The general level of the Erie Canal in the Mohawk Valley is some 20-odd feet above the river. This position must be favorable to leakage. The water in the canal must tend to escape through the soil and find its way to the river, the natural drain of the country. But if the canal generally occupied the bed of the river itself, the loss from leakage would certainly be greatly reduced.

This occupation of the river by the ship canal would not in my opinion work any injury to the existing water-rights. On the contrary, I think it would generally benefit them, because the United States would construct and maintain better dams than now exist there.

Q. How many routes have been proposed for the Niagara Ship Canal?—A. Some six routes were reported upon by Col. Blunt, but the one which starts from Tonawanda and goes in a nearly straight line to Olcott is undoubtedly the best route. It passes near Lockport and then descends in a natural gorge, which is a favorable place for the construction of locks down to Lake Ontario.

Q. I assume you are familiar with the other routes?—A. I have seen the results of the surveys and I know something of the ground itself. Three of these routes are simply for short canals around the falls, and return to the Niagara River before it enters the lake. None of them offer any advantage in cheapness or ease of construction over the Olcott line, and all of them are open to the very serious objection from a military standpoint, that one or both of their entrances is in view at short range of the territory of another nation. So that in time of war they could easily be blockaded or destroyed by land batteries.

The Tonawanda line, however, has its upper entrance behind a large island several miles in extent which belongs to us, and which might be fortified, while its lower entrance is in Lake Ontario, 18 miles from the mouth of the river.

Q. In the recent report are the estimates based on calculation or on the cost of other works?—A. They are based on the survey of the ground made in 1867, and such an examination as was then made to ascertain how deep rock would be found and what the character of the rock was. I think they computed the number of yards of rockwork the number of yards of earthwork to be done, as nearly as they could, and that the cost of the locks was based very largely on the actual experience gained in the construction of lock at Sault St. Marie, which is of course as safe an estimate as you can get.

Q. Have the processes of construction been improved largely of late?—A. Yes; immeasurably so. We have now means of transmitting power by electricity or by compressed air, which have been enormously improved of late, and we have a water power behind us that exceeds anything in the world. We can use this water power directly from the tunnel at Niagara Falls, or we can take it to Lockport, which would not be so far away. We can put in our water wheels and convert the power into the form of electricity and carry it along the sides of the excavations, and can run all dump cars, dredges, and drills by electric motors; and we ought to be able to accomplish

results in the way of economy and efficiency that have never been equaled in any work of this kind.

To illustrate what this power is: The total amount of earth that would have to be excavated, in order to form the Niagara Ship Canal according to the present project, is about 13,000,000 cubic yards. A large amount no doubt. If it were placed in a hemispherical mound it would bury the Washington Monument out of sight. But there is power enough in the water going over the Niagara Falls, if it could be applied and made to work, to excavate this enormous body of earth from the canal and place it on the bank in a little less than seven minutes.

Q. Do you think the various routes have been sufficiently investigated; that is, do you think it would be necessary to go over all the routes again in a survey?—A. In my judgment it would not; but I think, as has been suggested, that for the purpose of satisfying all criticism and convincing everybody that this the best route to take, and why it is better than any other that might be proposed, it would be well to extend the survey in sufficient detail over all the other suggested routes.

Q. I have no doubt that the different localities would have to have a hearing in order to decide the best route to take. We will be pestered to death if we did not give them a hearing. How long do you think it would take to have that survey made?—A. The survey of all the routes could be accomplished in one summer. It would simply be necessary to increase the number of surveying parties. That is, all of the field work could be done in one summer, and a report be prepared in the course of the following winter. I think a year would be the proper length of time in which to furnish a satisfactory report.

Q. What would be the probable cost of such a survey?—A. Well, if confined to the one route that I have suggested, it would cost from $35,000 to $40,000. If it were extended to include all the routes so as to be prepared to meet all criticism, I should say it might cost $100,000.

Q. Would not the survey, at present made on the Erie Canal route, be sufficient for determining whether that was a feasible route or not?—A. No, sir; it would show that this was a possible route for the Erie Canal, but that is not what we want. When it becomes a question of building a canal three times as deep as the Erie, we should encounter innumerable obstacles that did not trouble the smaller canal at all. Moreover, it would not be fair to this route to condemn it on the strength of what is known about the present Erie Canal, if the result of our examination of these facts should be unfavorable, for it might be that a different location, but one following something the same course, would be very much more favorable for a ship canal.

Q. The only practical route is through British territory, so that the only surveys necessary would be the Erie Canal route and the route you speak of.—A. Yes, sir; I think we can safely say that.

Q. I understand the present route of the canal from Oswego to Albany is not, in your judgment, as practical an one as a route which would seek a lower level in the beds of streams, and therefore there would have to be a new survey made.—A. Yes, sir; that is my opinion, particularly as regards the line in the Mohawk Valley

Q. Could not the surveys made by Col. Blunt, which cover from five to six different routes between Lake Erie and Lake Ontario, be utilized. Are they of a character to be utilized at this time?—A. They could be utilized to some extent; that is, they would take the place of preliminary reconnaissances. They would show the engineer where to look for what he wanted to find; but they would not be sufficient in other respects.

Q. Don't you think that even on these routes a less extensive survey could be made?—A. I doubt it. I think that a topographical survey of the proposed route should be carefully made, the nature of the ground should be examined at intervals of a quarter or a half mile by pits sunk to a depth considerably greater than that of the proposed canal, and the character of the rock should be carefully examined so as to ascertain its hardness and the difficulty or ease with which it may be worked; and all these things ought also to be carefully done over the Mohawk route.

Q. You are satisfied in your own mind, from preliminary examinations already made that this is the most feasible route?—A. Yes, sir.

Q. But only suggest as expedient, and to answer the criticisms of other contending interests, that it might be advisable to examine the other routes?—A. Yes, sir.

Mr. PAYNE. The chairman of the committee suggests that there may be some facts and figures that these gentlemen who have addressed the committee would like to add to their remarks, so that they may be incorporated with the printed documents.

The CHAIRMAN. These remarks can be revised and they can make it as full as they desire.

The CHAIRMAN. It is now 12 o'clock, but if the gentlemen would like to have a further hearing we can give them an hour on Thursday at the same hour as to-day.

Mr. SLOAN. I desire to thank the committee for the courtesy of offering us time for a further hearing; but I believe it is the general opinion that the question has been very ably and very fully discussed; that the ground has been thoroughly covered. We

are, therefore, quite willing to leave the matter as it is, expecting, of course, if any information can be given in regard to the wishes of those we represent, that such information will be given by our representative in Congress, Mr. Payne. We want to thank the committee for the favor, but we don't see there is any necessity for us to try to add anything to what has been already said.

Mr. PAYNE. I will be glad to give the committee any further information that is within my power.

The CHAIRMAN. Thursday is our regular day; and we will give Mr. Payne an opportunity to be heard on that day, if it is agreeable to the rest of the committee.

This was agreed to by the committee, with the proviso that the clerk be ordered to put into the notice that the hearing on that day is to be on this subject of water ways.

Adjourned.

APPENDIX B.

AN OPEN LETTER FROM HON. HORATIO SEYMOUR, FORMERLY STATE ENGINEER AND SURVEYOR OF NEW YORK, IN REGARD TO THE COMMERCE OF LAKE SUPERIOR.

MARQUETTE, MICH., *February 20, 1892.*

DEAR SIR: While to most men the commerce of the Lower Lakes is a familiar subject, Lake Superior is an unknown region. They are aware, perhaps, that iron, copper, and lumber are shipped from her ports, but beyond that they know very little. They look upon the Lake Superior region as a barren wilderness, with almost an Arctic climate and a sterile soil.

This is brought about by the fact that for many years railroad facilities were denied to the shores of Lake Superior, while they had penetrated beyond her to the Pacific coast. Lake Michigan bounds this region on the east, cutting off east and west lines of travel. In summer vessels coasted along the shore, but when the Great Lakes were closed with ice the only access to the outer world was by stages. This continued until the Chicago and Northwestern Railroad, attracted by the demand for the iron in the Marquette Range, built a railroad to within 13 miles of Lake Superior, and established the port of Escanaba on Lake Michigan, and followed this by the construction of two branches to the Menominee Range, an iron region lying along the Wisconsin line.

In 1877 the Wisconsin Central was built to Ashland. Since that time the Milwaukee and St. Paul, the Milwaukee, Lake Shore and Western, the Duluth, South Shore and Atlantic Railroads have been constructed to the shores of Lake Superior: the latter road working an east and west connection, both by Montreal and by Detroit, between the seaboard and Lake Superior. On the north shore, the Canadian Pacific, or its branches, touch at Sault Ste. Marie, Nepegon, and Port Arthur, and bring to the shores of the lake the grain of Manitoba and the Assiniboine Valley.

Running to the western end of the lake to-day are the Northern Pacific, the St. Paul and Duluth, the Eastern Railway of Minnesota, the Chicago, St. Paul, Minneapolis and Omaha, the Duluth and Winnipeg, the Duluth and Iron Range, and the Duluth, South Shore and Atlantic Railways.

The advent of almost all of these railways has been comparatively recent, and has been brought about by the necessity for moving to the lake ports the immense wealth of iron, copper, lumber, sandstone, and grain that is shipped through Lake Superior, and the return cargoes of coal and merchandise. The divisions of these great railways like the Chicago and Northwestern, and the Milwaukee and St. Paul, which connect with Lake Superior, are the most profitable of their lines, running as high as one hundred and fifty trains a day in order to transact their business. The iron of Lake Superior is distributed along its southern shore, through the counties of Marquette, Menominee, Iron, Dickinson, Baraga, Gogebic, in the State of Michigan, and on the north shore, in St. Louis and Lake counties in Minnesota. The greater part of this ore is shipped by water, and in 1890 amounted to a little more than 9,000,000 tons, a large body of which was of the highest grade of Bessemer ore.

The copper is found in Houghton and Ontonagon counties, in the State of Michigan. In the season of 1891 there was shipped 109,370,000 pounds, the value of which, at 11 cents a pound, would amount to over $12,000,000. The lumber, which is almost entirely white pine, from the great forests of Michigan, Wisconsin and Minnesota, contributed to the commerce of Lake Superior 366,305,000 feet B. M.

The sandstone, which is of a variety of colors of what is termed brownstone, is scattered along the shore of Lake Superior almost from one end to the other, rising above the waters of the lake and forming quarries easily worked, and near water transportation. The amount produced in 1891 was over 1,000,000 tons.

Of grain, there was transported 3,780.143 barrels of flour and 38,816,570 bushels of wheat, and 1,032,104 bushels of other grain. These articles, transported through Lake Superior, have enabled vessels to bring back cargoes at low rates; 2,507,532 tons of coal, 234,528 barrels of salt, and 417,093 tons of unclassified freight, mostly merchandise.

The total tonnage through the lake was 9,041,213 tons in 1890, and 8,888,759 tons in 1891. In 1881, ten years since, this traffic only amounted to 1,567,741 tons.

The increase in business on Lake Superior has been accompanied by a phenomenal growth in population. The county of Ashland, Wis., has increased in the last ten years from 1,599 souls to 20,063, an increase of 1,186.91 per cent; Bayfield, from 564 souls to 7,390, or an increase of 1,210.28 per cent; Douglass County, from 655 souls to 13,468, or an increase of 1,956.18 per cent; St. Louis County, in which Duluth is situated, from 4,504 souls to 44,862, or an increase of 896.05 per cent; Gogebic County, in Michigan, from nothing to 13,166 souls, and the other counties of the State of Michigan lying along the shores of Lake Superior from 60 to 80 per cent. This large increase in population appears, by the United States census, to be the growth of ten years, whereas it has actually taken place in a much shorter time.

The region lying along the shores of Lake Superior, if we can judge by the experience of territory similarly situated, is destined to sustain a large population, and the business done on the lake, although large, is but small compared with that which will be transacted in the future. The country is covered with a heavy growth of hardwood, among which there is a large amount of white and Norway pine. The soil is good, being composed of the drift carried along by the ancient glaciers. It is capable of raising grain of all sorts except corn, but there is a value added to the crop in this region that is exceptional. The mines, the quarries, and the commerce on the lake give to the farmer a speedy sale and a near-by market that other regions with a more favorable climate do not possess, and this demand will, in all probability, increase. The iron fields of Marquette, Gogebic, and Vermillion have been but partially developed, and larger mines and more numerous ones will be seen in the future. The output of copper increases year by year, and the market for lumber as well.

The farmer finds a sale for his hardwood for fuel or for charcoal, and millions of railroad ties, fence posts, and telegraph poles, can be sold at all the railroads and lake ports, while the cheap transportation on the lakes makes the merchandise and the groceries cheaper than where access can only be had to the commercial centers by rail. The manufacture of iron has yet only been started, but the success of furnaces, notably the "Hinkle Furnace" at Ashland, shows that the ore can be made into iron at a large profit near the mines. The large bodies of hemlock remain untouched, and hard and soft wood lumber have received as yet no notice, and will in time create furniture factories and tanneries that will give employment to thousands of operatives.

Large as the local business of Lake Superior will be in iron, copper, sandstone, etc., it is as a cheap channel for wheat and flour of the west that it will be celebrated within the near future. The western end of Lake Superior extends nearly 1,500 miles into the heart of our country, and is only 1,700 miles from the Pacific; it is immediately tributary to the great wheat belt that extends to the north, south, and west of it.

The following table from W. A. Livingstone, of Detroit, "Twenty-foot Channel," shows the comparative shipments of flour, wheat, and corn from the five principal lake ports for 1890 and 1891:

Ports.	Flour.	Wheat.	Corn.
	Barrels.	*Bushels.*	*Bushels.*
Chicago	1,757,745	7,030,707	57,529,820
Milwaukee	1,613,728	1,389,714	25,335
Duluth and Superior	2,496,000	13,874,707	1,453,010
Toledo	426,523	3,097,468	9,139,959
Detroit	432	2,961,378	372,798
Total	6,294,428	28,353,974	68,520,922

This shows that the grain seeks the nearest point of water transportation, and, although it has to be handled twice from rail to lake, and at Buffalo perhaps from lake to rail again, the economy of water transportation more than compensates for this outlay.

I also quote from Mr. Livingstone in regard to the receipts of coal during the seasons of 1889, 1890, and 1891, also the rates per net ton for carrying coal from Buffalo to the several lake points during the season of 1891.

Receipts of coal.

	1890.	1889.
	Net tons.	*Net tons.*
Chicago	1,256,505	1,329,363
Milwaukee	903,659	907,743
Duluth and Superior	1,681,525	1,209,000
Other Lake Superior ports	495,405	420,197
Other Lake Michigan, Huron, and Erie ports	1,504,837	
Other Lake Ontario and St. Lawrence River ports	900,000	

Rates for carrying coal.

Date.	Duluth.	Milwaukee.	Chicago.
April 14	$0.40	$0.50	$0.60
May 11	.40	.60	.60
July 18	.40	.50	.60
July 20	.30	.50	.50
August 12	.40	.50	.50
August 28	.30	.50	.50
September 2	.30	.40	.40
September 15	.25	.40	.40
September 26	.25	.50	.50
October 28	.25	.50	.60
October 29	.25	.60	.60
November 10	.10	.60	.60
November 18	.10	.75	.75
November 28	.10	1.00	.75
Average rate	.318	.545	.557

It will be seen from this last table that for a period the freight to Duluth on a ton of coal from Buffalo was only 10 cents. This wonderfully low rate was the return cargo for the boats carrying the 38,000,000 bushels of wheat shipped from the western end of Lake Superior in 1891. Its effect illustrated the blessing of cheap transportation.

Mr. S. A. Thompson, secretary of the Duluth Chamber of Commerce, says in regard to this cheap lake rate:

"Rates on coal from the East are lower than they are to Chicago, owing to circumstances into the details of which I do not care now to go, but because of this fact Duluth dealers have been able to sell coal as far south as Kansas City and to many other points which are much nearer to Chicago than they are to Duluth, and the cost of getting freight from New York to points in Montana, Kansas, Colorado, and the West generally is a great deal less than it would be if the Great Lakes were not where they are. As a further illustration of this fact, take the case of Aberdeen, Watertown, Huron, and other towns in South Dakota, where on the day they gained railroad connection with Lake Superior wheat went up 7 cents a bushel and coal came down $2 a ton."

The growing commerce of Lake Superior is not merely a local benefit: it adds to the wealth of every lake port. Commerce is a blessing that, while it takes, it gives back twofold. A ton of iron ore transported from a Lake Superior port stimulates many industries: it starts in motion shipyards that have grown to such proportion that they compete in the construction of ocean vessels with the great builders on the Atlantic; it builds up railroads to handle it and cities in which to load it and unload it. In its transformation into iron it has opened mines, employed coke ovens, and created furnaces; worth perhaps $5 a ton at the mines as merchant steel, it has increased twenty times in value. But this is

not all that it has accomplished. It has created a demand for coal as a return cargo, and has made a demand for food, furniture, clothing, building materials, and luxuries that must be supplied from the great cities of Chicago, Milwaukee, Detroit, Toledo, Cleveland, and Buffalo.

The opening of the commerce of Lake Superior has been of more than ordinary value to the commerce of the country. While the natural commodity transported on the Lower Lakes is grain, Lake Superior has added iron, copper, and sandstone, and will soon control the grain and lumber trade. This diversity of articles gives a constant and growing business, which, although it may suffer in time of depression, yet is more likely to provide a profitable traffic than if the articles transported were but one or two in number. The present season (1891) has illustrated this, for, although there is a partial depression, and the iron trade is not active, a large crop of grain and a foreign demand has made active business for the lakes and lake ports.

That the growth of Lake Superior business is not for the benefit of that region alone may be seen from the number of railroad lines reaching out from Chicago, Milwaukee, and Detroit, and that find, as the Lake Superior region grows, their business in passenger traffic to and from the great cities of the lakes, and their freight business, not only in coarse materials, but also in valuable and highly wrought and manufactured articles increases also. The most profitable railway lines are those that run in competition with the great water routes, and the roads leading to Lake Superior are no exception to the rule.

When we consider the benefits growing out of cheap transportation that inure to all parts of our country, we are not surprised at the efforts to lower the cost.

Increasing the depth and width of the channels, placing light-houses on the rivers between the lakes, and building danger signals and life-saving stations will all aid to do this, and it should be done at once; the outlay is but a small part of the value of one season's business, and any interruption to navigation will cost tenfold the amount that would be necessary to spend to insure against such disaster.

In order to show the benefit to be derived from a 20-foot channel I quote again from Mr. W. A. Livingstone:

"To understand what this improvement means, take the effect on one of the present steamers. This year the draft of water permissible through the St. Marys River has varied from 14 to 14½ feet. Through Lake St. Clair (Grosse Pointe) the draft has varied from 15 to 16 feet. On 14 feet 3 inches draft through the 'Soo' the steamer *Maryland* would carry about 2,875 net tons of cargo; were there a 20-foot passage and were she loaded to 19 feet draft she would carry about 4,550 net tons of cargo. This means that where she now carries cargo at $1 per ton *free in and out* from Lake Superior on a draft of 14 feet 3 inches, she could then afford to carry cargo at 63 cents per ton in 19 feet draft and still make the same net earnings as she does now at the higher freight. Or, where she now carries for $1 per ton on the Lower Lakes on a 16-foot draft, she could then carry for 76 cents per ton and make the same earnings."

With all the business done on Lake Superior there have been certain dangers and difficulties in navigating the St. Mary's River that have been a tax on the commerce of the country. In 1881, when the new lock was completed, it was expected that vessels could draw 16 feet of water, but during the past season this has been reduced to 14 feet, while the depth of water through the St. Clair Flats Canal has been 16 feet.

It is necessary, in order to pass the St. Marys River, that it be done in the daytime, and therefore all boats must arrange their time so that they reach the lock about noon; this creates an accumulation of boats and delays the lockage. The channel of the river is narrow and crooked, so narrow that the sinking of the boat named the *Susan E. Peck* completely blocked the passage, and a channel had to be dredged around one end of the vessel to open navigation. This obstruction cost at least $146,236 in delayed navigation. How much more it cost in diverting business from the lakes can not be known.

A difference of a foot in draft takes off about 300 tons from the cargo of a large vessel, or about one-fifth of her cargo. This is sufficient to drive boats away from the Lake Superior business, especially if they can load to a greater depth with less delay. A large vessel must be allowed to travel at her full speed and run no risk of collision or accident. Through the narrow channel of the St. Marys River, with no sufficient light-houses, vessels can not run at more than half speed, and the danger of collision or going aground when loaded boats are passing in the contracted parts of the river are very great. Business can not afford to take such risks, and such evils not only drive away commerce, but make the business that is done pay a higher rate than it should do.

Owning to the lack of lights on the St. Marys River there are ports of Lake Superior where boats arrive in one direction in the night only, and all the business of loading and unloading must be done at that time or the vessel must be delayed for hours.

The amount asked by Gen. Poe for a 20-foot channel, $3,394,835.96, and the construction of a new lock at the Sault will do much to correct these evils, but the amount asked for will not be appropriated without an effort, in which all the territory around the Great Lakes must join. It must be shown not only to the States bordering on the lakes, but to the West and East and South, that the country is benefited as a whole by what is so essential for the good of the largest part of our Union.

With a view to aid this cause, I have taken the liberty of writing you this letter, knowing that, as a citizen of New York, a State that owes its prominence to its waterways, you will be interested in any project that will cheapen transportation.

Very truly yours,

HORATIO SEYMOUR.

Hon. HENRY W. BENTLEY, *M. C.*,
House of Representatives, Washington, D. C.

APPENDIX C.

FROM THE WEST AND NORTHWEST TO THE SEA.

[A paper by William Pierson Judson, member Am. Soc. C. E.]

The West and Northwest must have the best possible waterway to the sea. The best waterway is that by which the largest practicable lake steamers can go nearest to the sea by deep-water navigation without breaking bulk.

Such a route can be made either through the United States or through Canada, and the great profits of the carrying trade, which is vastly increasing every year, and which exceed the profits of production, will go to that nation which provides the best way.

Each government has expended large sums to improve their natural waterways; the present magnitude of the commerce calling for these improvements being indicated by the 20,000,000 of tons passing the St. Clair Flats Canal yearly.

The United States has met the demand by the construction of the Sault St. Mary Canal at the outlet of Lake Superior, having the finest and largest lock in the world, with a still larger one* now in progress; also, by the excavation of the St. Clair Flats Canal at the outlet of Lake Huron, and by the deepening of the Detroit River at the entrance to Lake Erie.

The latter being completed and the others in progress to pass 20 feet draft.

The logical sequence of the liberal policy, each step of which has been followed by a great growth both in size and number of vessels and in volume of commerce is to also provide a similar 20-foot waterway from Lake Erie to Lake Ontario.

The Western demand for this further step toward their Eastern market was recognized by the last Congress in its call for plans and estimates for a 20-foot ship canal around Niagara Falls.

These estimates,† reprinted here, were made and submitted to Congress, where they were soon followed on December 18, 1889, by the introduction by Congressman Sereno E. Payne (since made chairman of the Committee on Railways and Canals) of a bill, also here reprinted, providing for the work. This bill now awaits Congressional action.

The essential points of the plans and estimates are also embodied on the sheet of maps and profiles which have been made for and which accompany this paper. The map shows some of the main connecting and competing lines of both railways and canals with the Niagara region on a larger scale.

The profiles show the two practicable routes, which are the only ones, of many surveyed, which are worthy of consideration for the large locks (400 by 80 by 21 feet) now desired.

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* Eight hundred feet long between gates, 100 feet wide in gates as well as in chamber, and 21 feet deep on miter sills. Report Col. O. M. Poe, Corps of Engineers, An. Rep. Chief Engineers, U. S. A., 1889, p. 2223.

† Report Capt. Carl. F. Palfrey, Corps of Engineers, An. Rep. Chief Engineers U. S. A., 1889, p. 2434.

The eighteen locks estimated for take as their model the 1881 lock of the Sault St. Mary Canal, which, being designed to pass two or more vessels at once, is therefore larger than needed for the Niagara Canal, being 515 feet long, 80 feet wide, and 16 feet deep.

This lock, with its unique methods of operation, has had nine years of uninterrupted use, and all its details have been proven to be so perfect as to leave no room for improvement; a most fitting monument to the skill and wisdom of the late Gen. Godfrey Weitzel, who planned and built it, having as the only comparable precedent his own similar works in 1871 on the Louisville Canal at the Falls of the Ohio.

Of the two routes selected for the Niagara Ship Canal, the longer one of 25 miles, known as the Lockport—Olcott, or Eighteen-Mile Creek route—is preferable, and is estimated to cost $23,000,000.

It offers remarkable natural advantages for construction as well as for operation, in the "Lockport Gulf," 2½ miles long, in which the descent is made, and also in the Eighteen-Mile Creek gorge, 4 miles long, by which Lake Ontario is reached.

It is to be regretted that the striking features of the routes selected can not be here shown better than by description, by reproducing a series of photographs taken by the writer in 1889, while examining in detail the various lines.

The six millions greater cost of the Wilson route, which is 5 miles shorter, is due in part to its lack of the natural features above referred to, and in part to the necessity for doubling nine of the locks to obtain the service which single locks give on the Olcott line.

□ The United States Government has not been alone in its works for the lake commerce, for meantime the Canadian Government, despite its comparatively small population and limited resources, has spent some $54,000,000 in constructing and recently in enlarging its canal system, with a view to controlling the western trade.

This system now consists of the 14-foot Welland Canal from Lake Erie to Lake Ontario, around Niagara Falls, and of the St. Lawrence River canals around the various rapids by which the outflow of the lakes descends from Lake Ontario through 246 feet of fall, to tide water at Montreal.

These last-named canals—6 in number, with 26 locks—have an original depth of 9 feet, which is now in process of increase to 14 feet.

From Montreal, now practically a seaport, a 27½ to 30 foot channel for seagoing steamers has been made at a cost of some $2,500,000, their voyage thence to Liverpool being 315 miles less than from New York.

That portion of the shipment from the upper lakes which passes through the United States and reaches New York, is taken from Lake Erie at Buffalo by 352 miles of the 7-foot Erie Canal to the Hudson; and from Lake Ontario at Oswego by the two branches of the Erie Canal, via Syracuse and via Oneida Lake, the latter route having 184 miles of canal and river and 23 miles of Oneida Lake travel to reach the Hudson.

The deep waters of Lake Ontario are now, however, practically unused for this traffic, the only important western shipments passing through it for American ports being to Ogdensburg, for shipment thence by rail; the only access to Lake Ontario from the West being through the 14-foot Canadian Welland Canal.

This is too small to pass the larger upper-lake steamers, and the discrimination in tolls which is made against vessels bound for American ports is such as to be almost prohibitory. Nominally, the tolls are the same to all vessels, and are 20 cents per ton of cargo and 2½ cents per ton of vessel; but the amount is refunded or rebated to vessels which deliver their cargos at a Canadian port.

Observation of the map will recall the striking advantage of Canada's position as regards the lakes, and will suggest that the United States can not afford to omit any reasonable work which will offset this natural advantage.

The works best calculated to effect this, and which also promise the greatest value, aside from any competitive aspect of the case, are the Niagara Ship Canal the projected lakes and gulf water way to the south; the latter running from Chicago and carrying the waters of Lake Michigan along the line of this original natural outlet down the valley of the Illinois River to the Mississippi and the Gulf.

These two projects, which are both strongly favored, should not be considered as rivals, since many of the reasons for one are equally applicable for the other,

and their combined effect, added to the present great growth of lake shipping, would supply ample business for both.

The latter project is most ably presented by Mr. L. E. Cooley, civil engineer, of Chicago, in his publication of 1888, containing a great amount of valuable data, and also in a subsequent discussion of it published in 1889 under his direction.

Already Canada is taking further steps to improve the natural advantages of her position by completing a separate canal system. Not content with using the United States Sault Saint Mary Canal, Canada, has now in progress (1890) a similar canal on the opposite side of the Rapids, less than a mile from ours.

This great work is undertaken despite the fact that the United States canal is free of tolls to Canadian vessels as well as to our own.

The contracts for the entire work are now in force, providing for an 18-foot canal, with lock 600 by 85 feet, operated by hydraulic machinery. The contracts call for completed work to be ready for use in May, 1892.*

When the Canadians are thus made independent of our "Soo" Canal, what terms may our vessels expect at the Welland?

On the other hand, it has been asserted that all tolls will then be removed from the Welland. The policy as regards United States vessels may vary with every change of ministry. No terminal arrangements can be made with any assurance of permanence, so long as we must depend upon a Canadian canal.

Surveys and estimates have also been made for an almost direct line of water way from the Sault St. Marie and from Lake Michigan to Montreal through Lake Nipissing and the Ottawa River, the latter having already canal navigation for† 9 feet draft to Ottawa and for 5 feet draft 145 miles beyond, though at present the 5-foot portion is not kept in repair.

A glance at the map accompanying will show that this line, lying far within Canadian territory, would cut out Lakes Huron, St. Clair, Erie, and Ontario, as well as the St. Lawrence Rapids, thus saving 270 miles. The distance by it is practically the same from Lake Superior to Montreal as by the present lake route from Lake Superior to Buffalo.

Its construction, even for a 9-foot barge route, is not probable, but the possibility exists, for the route offers great advantages. The summit level, 77 feet above Lake Huron, has ample water supply, and in the total length of 430 miles, only 29 miles is canal, the rest being river and lake.

The object in here stating, at such length, the present and prospective features of the Canadian routes, is to show that New York City, as well as the West and Northwest, is directly interested in the effects of the proposed works.

The result of Canada's liberal policy is already shown in the gradual increase in Montreal's share of the total exports, while New York's share as steadily decreases.

The reverse has recently been stated to be the case, but these comparative percentages are carefully computed from official records of the several chambers of commerce or produce exchanges, and show a gradual change, in ten years past, of 4 per cent in grain and 5 per cent in flour, in Montreal's favor.

This gain has been made despite of Montreal's having "only six months of the year of navigation," as stated by one of her most noted engineers. The actual average dates‡ of first arrivals and last departures for many years past have been May 2 and November 23.

A stronger and fairer showing would have been made if there could have been included the Canadian shipments brought in bond via the Grand Trunk Railway to Portland, Me., and exported thence when Montreal's harbor was sealed by ice, Portland being practically Montreal's winter port.

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*Annual Report Canadian Minister Railways and Canals, Ottawa, 1890, p. 111.
†Annual Report Canadian Minister Railways and Canals, Ottawa, 1890, p. 103.
‡Annual Report Harbor Commissioners of Montreal, 1887.

Comparison of exports of grain and flour from New York City and from Montreal, showing the percentage of the sum total which each city exports.

PERCENTAGE OF SUM TOTAL.

[Grain, bushels; flour, barrels.]

Years.	Grain.		Flour.	
	New York.	Montreal.	New York.	Montreal.
1880	84	16	85	15
1881	83½	16½	87½	12½
1882	82½	17½	85½	14½
1883	82	18	85	15
1884	83	17	82¼	17¾
1885	82¼	17¾	84½	15½
1886	77	23	82½	17½
1887	80	20	81½	18½
1888	82	18	82½	17½
1889	80	20	79¾	20¼

A further similar comparison of the respective percentages of total exports of New York City and of the other North Atlantic ports, including Montreal, shows even more clearly that no effort can be spared if New York is to keep her present supremacy.

The percentages only are given, as the fluctuations of yearly quantities, with the varying supply and demand, are less readily compared.

Comparison of grain and flour exports from New York, Boston, Philadelphia, Baltimore, and Montreal, showing the percentage of their sum total which each city exports.

PERCENTAGE OF SUM TOTAL OF GRAIN.

[Bushels.]

	New York.	Boston.	Philadelphia.	Baltimore.	Montreal.
1880	49¾	6½	13	21	9¾
1881	50½	7½	10½	21¾	9¾
1882	55½	5½	7½	20¾	11¼
1883	49¼	6¼	9½	24	11
1884	52	5¾	8½	23½	10½
1885	53	6½	10	19	11½
1886	49½	6½	7½	22¼	14¾
1887	52¾	6½	10¼	17	13½
1888	56	9½	4	17½	13
1889	49	9	5¾	24½	11¾

PERCENTAGE OF SUM TOTAL OF FLOUR.

[Barrels.]

	New York.	Boston.	Philadelphia.	Baltimore.	Montreal.
1880	62½	16	3½	7	11
1881	66½	15½	2½	6	9½
1882	62½	18½	2½	6½	10½
1883	57	22¾	4¾	5½	10
1884	45	36½	3½	5	9¾
1885	47½	21½	8¾	14	8¾
1886	41½	24¾	5	20	8¾
1887	38½	20	4¾	28½	8½
1888	40½	17½	7½	26½	8½
1889	40¼	15½	6½	27½	10½

It has been objected that the proposed 20-foot Niagara Ship Canal would pass the great upper lake steamers to Lake Ontario, only to see their cargoes go down the St. Lawrence to Montreal, instead of through the Oswego and Erie Canal to New York.

As has already been stated, the navigable depth of the St. Lawrence River and canals to Montreal is now limited to 9 feet, with an ultimate proposed depth of 14 feet, to which portions have been deepened. A 20-foot Canadian system would be impracticable, having been estimated to cost $70,000,000 additional; while deep-water navigation, among its Thousand Islands and its thousands of of submerged rocks, would require most skillful pilotage in clearest weather.

These dangers to navigation on the St. Lawrence increase vastly in number for any additional drought.

Twenty-foot vessels which might pass our canal, and desire to transfer at Kingston to barges for Montreal, would be prevented by the same rebate system which now operates so effectively against us on the Welland Canal.

So that there are both physical and financial sureties that New York, as well as the West and Northwest, could lose nothing, but must gain much, by the proposed Niagara Ship Canal.

It is now fortunate that its construction was not begun in 1867, upon the inefficient scale then proposed, which is practically that of the present Welland Canal, which was outgrown before it was finished. The canal, when built upon the present project, will pass the largest steamers which can navigate the lakes.

These steamers will be able to place their cargoes at Oswego twenty hours after passing Buffalo. This assumes a much quicker passage of the proposed canal than is possible or is permitted in the Welland Canal, whose passage is not allowed to be made in less than twenty-two hours. This appears to be fixed on a basis of 5 miles per hour speed and forty minutes per lock.

The shorter time here estimated for is based upon the improved methods proposed. The lockages will be fewer and each will be quicker by reason of the hydraulic appliances and the methods of filling and emptying which have proved so perfect at the Sault St. Mary lock. This at the Sault requires the movement of five times the water moved in a Welland lockage, but it is effected quietly in an average of twelve minutes for each filling or emptying: while an additional twenty-eight minutes is required to haul in and to place the two to four vessels which fill the lock to close and open the gates and to haul the vessels out—in all, an average of forty minutes per lockage.

The writer is indebted to Gen. O. M. Poe, U. S. Engineers, who has charge of the canal and is building the new lock, for these details of operation.

In the Niagara locks, one-fourth smaller, a single steamer will readily pass in thirty minutes.

The earth slopes being paved, speed can be made on the two long levels of 6 and 12 miles each, which form three-fourths of the total length.

The Niagara Canal can be thus passed in eleven hours, and the run of 110 miles to Oswego can be made in eight hours. At Oswego, the cargoes transferred to canal-boats are then 145 miles nearer to New York than at Buffalo, and have 168 miles less of canal to traverse to reach the Hudson.

The average of many trips to the Hudson of steam canal-boats with consort, shows six days from Buffalo against four days from Oswego.

This shows a clear saving of one and one-fifth days, or 20 per cent of the time of the present trip from Buffalo.

Having two independent and competing water routes available, shippers would also save the present excessive elevator charges at Buffalo.

It is no part of the present Niagara Ship Canal project to provide for a canal of similar size through New York State to tide water, as has been estimated for at various times, by which lake steamers should carry their cargoes to New York or to Europe.

Such projects call for impossible expenditures, and ignore the fact that different waters demand different types of vessel. The lakes, the canal and river, and the ocean, each have their distinctive style and equipment.

Such a water way, if built, would not be so used. Steamers fitted to safely weather lake storms would not carry their costly and idle equipment through 360 miles of canal and river to New York. Barges of one-tenth the cost would do the work better and cheaper, while much of the expensive construction needed on the ocean would be superfluous on the lakes.

The present 7-foot canal will be fully equal to vastly greater business than it has ever done, when the double length locks—220 feet long by 19 feet wide—now in construction on the Oswego and Erie canals, are completed, and when the

present prism is cleared of accumulations and weeds and its slopes paved, as has been repeatedly urged by the State engineer. Or if enlarged to 9 feet depth at the locks, with 10 feet water way, the present canal would pass the modern McDougal steel barges or other canal boats of ample size to do most efficient and profitable service.

For such enlargement of the Oswego, Oneida Lake and Erie Canal moderate estimates of cost have been made and ample local water supply found.*

The military advantage to the United States of being able to bring gunboats through from New York Harbor is obvious. Gunboats of 12 feet draft could readily be lightened of their armament and stores to pass the 9-foot canal and from it, through the Niagara ship canal, the chain of lakes could be commanded, with the effect of saving, in case of merely threatened hostilities, much greater sums than the canal would cost.

The only gunboats which can now reach the lakes are those which may come up the St. Lawrence and the Welland Canals, by the permission of Canada, who thus has unquestioned command of all our utterly defenseless lake commerce and cities.

Simply regarded as a military work, the Niagara ship canal would be an economical substitute for otherwise needed defenses of the northern frontier. But unlike most military works, it would be still more valuable for peaceful commerce

MARCH 1, 1890.

APPENDIX D.

REPORT OF CAPT. CARL F. PALFREY, CORPS OF ENGINEERS, U. S. A.

[Reprinted from the Appendix of the Annual Report of the Chief of Engineers for 1889, page 2434.]

WATER WAY AROUND NIAGARA FALLS OF CAPACITY AND FACILITIES SUFFICIENT TO FLOAT MERCHANT SHIPS AND SHIPS OF WAR OF MODERN BUILD, DRAWING 20 FEET OF WATER, SAID WATER WAY TO COMMENCE IN A NAVIGABLE PART OF NIAGARA RIVER, IN NIAGARA COUNTY, NEW YORK, AT OR NEAR TONAWANDA, AND TO END IN THE NAVIGABLE WATERS OF SAID RIVER BELOW SAID FALLS, OR IN NAVIGABLE WATERS CONNECTED THEREWITH.

UNITED STATES ENGINEER OFFICE, *August 19, 1889.*

GENERAL: I have the honor to report as follows upon revision of surveys and estimates for water way around Niagara Falls, New York, heretofore made by Col. C. E. Blunt, Corps of Engineers.

The river and harbor act of August 11, 1888, under which this revision is made, contains the following paragraph:

"Water way around Niagara Falls of capacity and facilities sufficient to float merchant ships and ships of war of modern build, drawing 20 feet of water, said water way to commence in a navigable part of Niagara River, in Niagara County, at or near Tonawanda, and to end in the navigable waters of said river below said falls, or in navigable waters connected therewith. For the purposes hereof the Secretary of War, in his discretion, may take into consideration, and revise the surveys and estimates of such a water way heretofore made by Brevet-Colonel C. E. Blunt, of the United States Corps of Engineers, in compliance with a joint resolution of the Congress approved March twenty-second, eighteen hundred and sixty-seven."

The canal for which Col. Blunt made surveys and estimates was of 14 feet depth, with lock-chambers 275 by 46 feet. His surveys covered six lines, some of which presented great difficulty in the ascent of the Niagara Terrace even with these dimensions, and only one, the longest, offered any marked natural advantage. None of these is impossible with the dimensions now required; routes No. 1, 2, 2*a*, 3, and 5*a* do not come within the description of the act above cited, the

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* Report of the late Mr. James S. Lawrence, C. E., to Maj. (now Col.) John M. Wilson, Corps of Engineers, An. Rep. Ch. Engr. U. S. A., 1875, part 2, p. 566. Also report Mr. C. A. Olmstead, C. E., to canal commissioners, 1871.

last being without Niagara County, the others opening upon Niagara River 9 miles below the present termination of a 20-foot depth. No estimates upon these are therefore presented. Examination of the ground and application of the present project to the profiles of these routes have shown me that they offer no advantage either in expense of construction or efficiency of service. Route No. 4 also opens upon the river at a point below the present termination of 20-foot depth, but near enough to it to come reasonably within the terms of the act. Of all the routes surveyed by Col. Blunt it is the only one remaining for comparison with route No. 5. Projects and estimates upon these two routes are therefore presented.

The dimensions of canals and locks adopted and used in all the estimates are as follows:

	Depth.
Width of canal at bottom	100
Depth of canal	20½
Width of canal at water-surface in rock	100
Width of canal at water-surface in earth	150
Length of lock-chamber	400
Width of lock-chamber	80
Width of gates	60
Depth over miter-sill	21
Lift, in general	18

I assume that the lock at Sault St. Marie, Mich., completed in 1881, as the model of locks and their works, and also assume that the canal will be used by vessels either self-propelling or towed by tugs. All slopes are therefore paved.

The sections herewith presented show the form of cutting upon which estimates are based. I have arranged upon both routes for the ascent of the Niagara Terrace by a system of locks 400 feet long and 80 feet wide, and short levels or basins 500 feet long and 100 feet wide. With this system, for draft of 14 feet, the lock can be filled from its own basin and the lock next above without danger from grounding; for draft of 16 feet the lock can be filled from its own basin and the basin next above without danger of grounding in either; for draft of of 17 feet, from its own basin and the two above without danger of grounding in any.

Upon route No. 4 this gives fairly efficient service with single locks, but for full efficiency double locks are still needed upon this route. Upon route No. 5, by virtue of a level of 2,100 feet midway of the ascent, efficient service can be had from single locks.

At the lake end of each route is a shallow natural harbor, with harbor improvements on a scale utterly inadequate to the needs of this water way.

At each I estimate for a channel 200 feet wide to the deep water of the lake, protected by piers of cribwork filled with stone. At each harbor the inner 500 feet of this channel is in water fully protected from storm, being part of the natural harbor.

At each lake front the bottom of the lake is of a soft red stone, which can be worked by the dredge. A similar formation at Oak Orchard has been removed by dredging to a depth of 10 feet at extreme low water (12 feet at ordinary low water), at a contract price of $1.10 per cubic yard.

The requirements of bridging are not materially changed since the date of Col. Blunt's report. The surface width of the canal is unchanged, and I have held, where there is any change, to lower levels than he. In the wide range of estimate open in this matter I have held to his.

ROUTE NO. 4.—WILSON OR TWELVE MILE CREEK LINE.

Length, 18.35 miles; 18 lifts; estimated cost with single locks, $24,201,550; estimated cost with double locks, $29,347,900.

"This line commences at the mouth of Twelve Mile Creek, and following its course about half a mile the line reaches the table-land, and thence in a southerly course for 9½ miles over gently rising ground, very favorable for the location of a canal, it reaches the foot of the mountain ridge. At this point the ascent commences. and a second table-land is passed. Continuing a southerly course, the line crosses the Pekin road, and half a mile farther the summit is reached, the line descending into the valley of Cayuga Creek to the Lockport and Niagara Falls Railroad. From thence it takes a southwest course along the valley of the creek to Bergholtz; thence nearly on the same course to its

termination at a point on the Niagara River 2 miles east of Cayuga Creek, the whole distance being 18.35 miles."

Beginning at the mouth of Twelve Mile Creek, this line rises with nine lifts and with levels ranging from 2,000 to 9,750 feet, to the base of the cliff. This portion of the line is entirely in earth-cutting. The natural surface of the ground is fairly uniform. It is highly cultivated in wheat and fruit. The ascent of the cliff is made by nine lifts of 17½ feet each, with levels uniformly 500 feet long between, thus reaching the summit level, fed from the Niagara River. The cliff is abrupt, with a thin cover of earth over most of its face. The crest is at about 60 feet above water level. There is a secondary terrace about two lifts below the summit level. It could be utilized for a level only by giving up the intermediate basins through the whole system and incurring the expense of double locks, and even then, leaving three-quarters of the ascent unbroken, it would add little to efficiency. On the summit level this line is very expensive by the depth of the rock cut. The system of locks and basins gives on this line a moderate efficiency, with single locks, for draft of 14 feet. For the deeper drafts, although passing on the incline is possible, with careful management, at several points, the service of the upper locks must often be sacrificed to the need of replenishing the lower. For full efficiency double locks are necessary, which adds largely to the expense of the line. The locks to be doubled are all in rock-cutting, where masonry is reduced to the minimum, and the expense of double looks in these circumstances is nearly double that of single ones.

In the Niagara River this line requires a dredged channel about 16,700 feet long. This is estimated as in sand and gravel, as the rock-beds are uniform, and no rock appears in the bed of the river for many miles.

One railroad bridge is required on this line not included in Col. Blunt's estimate. The Rome, Watertown and Ogdensburg Railroad crosses the line at a level little above the water-surface.

The lake harbor estimated for includes a moderate area of sheltered mooring. Should commercial needs require it, a basin can be obtained by dredging in Wilson Harbor.

ROUTE NO. 5.—OLCOTT OR EIGHTEEN-MILE CREEK ROUTE.

Length, 25.28 miles; lifts, 18; estimated cost, $23,617,900.

"The line of survey begins at the head of Olcott Harbor, on Lake Ontario, 18 miles east from the mouth of the Niagara River, following the channel of Eighteen-Mile Creek (the course of which is nearly south and very direct) for 3⅞ miles; ascending gradually, reaches in 1½ miles the table-land, over which it passes for 5¾ miles nearly south to the foot of the mountain ridge, when it enters another valley or gulf 2½ miles in length, varying in width from 80 to 300 feet on the bottom, which is gradually ascending with steep banks on both sides; this is followed to its head, where the mountain ridge is encountered. From the head of the gulf the line follows a slight depression in the ridge, leading in a tolerably direct course west of south 4 miles to the east end of Beach Ridge; thence by an almost direct line nearly southwest to the Niagara River, opposite the north end of Tonawanda Island, about seven-eighths of a mile north of the mouth of Tonawanda Creek, making the whole distance 25 miles 22.34 chains."

Beginning at the mouth of Eighteen-Mile Creek this line rises by seven lifts to the entrance of a remarkable gorge in the face of the cliff near Lockport, locally known as "The Gulf."

In this part of the line there is a little rock cutting in the bed of the creek and at leaving it; thereafter it is all in earth cutting. It has the advantage of one level nearly 6 miles long, in which good speed can be maintained. The country traversed after leaving the creek is in part cultivated in wheat; in part, hay land. "The Gulf" offers a comparatively easy ascent of the cliff by four lifts with levels or basins 500 feet long; then one lift with basin 800 feet long; then one lift and level 2,100 feet long; then five lifts having intermediate basins 500 feet long, to the summit level. On the summit level this line is free from rock cutting after less than 3 miles.

On this line efficient service can be had from single locks. The level midway of the ascent is an important aid. For 14-foot draft one lock full of water can be taken from the 800-foot level and two from the 2,100-foot level for the service of the lower locks before drawing from the summit level through the upper locks becomes necessary. For 16 and 17 foot drafts one lock full can be so drawn from the 2,100-foot level. The terrain of the gorge makes it easy to provide a storage basin of very moderate depth, into which water may be allowed to fall from the summit level and thence drawn off without inconvenient head to the 2,100-foot level.

This would leave the upper set of five locks entirely free from the service of replenishing the lower set, and would add greatly to the efficiency of the system.

In the Niagara River this line requires a dredged channel about 5,000 feet long. The 20-foot depth appears again farther down the river. The bar between White's Island and the mainland is therefore estimated as sand and gravel.

The bridge of the Rome, Watertown and Ogdensburg Railroad, not built at the time of Colonel Blunt's report, crosses this line where it occupies the bed of Eighteen-Mile Creek at a level far above the water-surface. One-half the cost of a bridge is estimated for changing this to a swing-bridge.

The lake harbor works estimated for include a moderate area of sheltered mooring. Should commercial needs require it, a basin can be obtained by dredging in Olcott Harbor.

Detailed estimates upon the two routes are appended.

Profiles and sections are herewith presented.

I have the honor to be, very respectfully, your obedient servant,

CARL F. PALFREY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. ARMY,
Washington, D. C.

APPENDIX E.

LETTER FROM VERPLANCK COLVIN, NEW YORK STATE SUPERINTENDENT OF ADIRONDACK SURVEY.

ALBANY, *December 28, 1891.*

MY DEAR SIR: I have your letter of the 26th instant relating to proposed ship canal to connect the Great Lakes with the Hudson River. Two routes may be mentioned.

(1) The route via the Mohawk Valley, Oswego, Lake Ontario, and Niagara Canal to Lake Erie.

(2) The route via the Upper Hudson Valley, Lake Champlain, and canal along the Canadian frontier to the St. Lawrence River; thence via Lake Ontario and the Niagara Canal to Lake Erie.

The Valley of Black River, near or along the Black River Canal, is inadmissible as a route owing to the great elevation of the summit, which is 1,120 feet above tide; rendering over 100 locks necessary. There would also be much expensive construction, while floods on Black River would make it an undersirable channel.

Considering the two routes first mentioned, we have—

(1) *The Champlain route.*—This line would have the least engineering difficulties, but would, probably, have to traverse a portion of Canada to take advantage of the best location. For a national United States canal this difficulty might prove insuperable.

This route has no disadvantages except the political or national impediment, which survey may prove not to exist. The maximum elevation on the Champlain route is the height of Lake Erie: the only divide crossed is on the Upper Hudson, 150 feet above tide. The elevations are as follows:

	Feet.
Hudson Valley summit	150
Fall to Lake Champlain	54
Rise to Lake Ontario	151
Rise to Lake Erie	326
Total rise and fall	681

Total number of locks, 45.

Distances by Champlain route would be—

	Miles.
Canal, Troy to Lake Champlain	65
Navigation to Lake Champlain	124
Canal to the St. Lawrence	90
Navigation, St. Lawrence River	92
Navigation, Lake Ontario	150
Canal at Niagara River	25
Total distance	546

Canal to be constructed	180
River and lake navigation	366
Total as above	546

Time by steamer from Troy to Lake Erie, two and one-half to three days.

This is a magnificent route with abundance of water; hardly any elevations to overcome; no cities to interfere by large bridges; and the canal would be cheap and easy of construction.

(2) The improved "Erie" route, or Mohawk Valley Canal, from Troy via Oswego and Lake Ontario to Lake Erie. On this line the elevations are as follows:

	Feet.
Mohawk Valley summit	427
Fall to Lake Ontario	180
Rise to Lake Erie	326
Total rise and fall	933

Total number of locks, 62.

Distances by the Mohawk Valley route are—

	Miles.
Canal, Troy to Oswego	195
Navigation, Lake Ontario	130
Niagara Canal	25
Total distance, Oswego route	350
Total canal to be constructed	220

This route has seventeen more locks than the Champlain route, which increases time and expense, though the distance being less, decreases the time consumed by each voyage.

The time by this route, by steamer from Troy to Lake Erie, about two days for large steamers or men of war.

This route will have a sufficient water supply, for suitable reservoirs can be arranged to furnish all the water needed. It is a perfectly feasible route, located entirely in the State of New York.

COST OF SURVEYS.

I would suggest a reconnaissance of the northern route, via Lake Champlain and the St. Lawrence River, to ascertain whether the canal can not be kept within the United States, as this route would be much the cheapest in construction, 40 miles less of canal being required, with minimum lockage, and nearly as quick a route as the shorter lines, yet costing at least $4,000,000 less than any other route.

For this survey, determination of possible location in United States, I would suggest an appropriation of $17,000.

If the 195-mile line along the Mohawk Valley, from Troy to Oswego, should be accurately surveyed to determine the best possible location for ship canal—independently of the Erie Canal and avoiding passage through cities and large towns, whose street bridges would be a hindrance to traffic—then a great deal of careful surveying would have to be done.

A trial line could be run for about $30,000 to $35,000, or, if the 25 miles around Niagara Falls be included, then from $35,000 to $40,000. Based upon the trial lines, some secondary lines would be needed to better or improve the first line in places.

The final survey for estimates of quantities and cost of construction would not probably follow precisely any of the preliminary lines, but would be a line resultant from the prior investigations.

The final survey for estimates along the located line would cost about	$60,000
To which adding cost of preliminary surveys	40,000
And reconnaissance surveys of the Champlain route	17,000
Total cost of all surveys	117,000

This would not include cost of engineering supervision during construction, but would give the location of the several ship-canal routes available through the State of New York.

The time required for these surveys would be between one and two years. The work would have to be divided into four or five divisions, under one general direction, which, with its share of the general expense of supervision, costing about $1,000 per month.

Five divisions, at $1,000 per month for twelve months	$60,000
Four divisions, next year, twelve months	48,000
Allowance for special work	9,000
Total, as before	117,000

A poorer quality of work might be had for less money, but the determination of a final route with complete estimates for quantities could not be made at less cost.

Yours very truly,

VERPLANCK COLVIN.

Hon. H. W. BENTLEY,
House of Representatives, Washington, D. C.

APPENDIX F.

THE RADICAL ENLARGEMENT OF THE ARTIFICIAL WATER WAY BETWEEN THE LAKES AND THE HUDSON RIVER.

[A paper by E. Sweet, M. Am. Soc. C. E., read at the Annual Convention, June 10, 1884.]

WITH DISCUSSION.

The Erie Canal, conceived by the genius and achieved by the energy of De Witt Clinton, was, during the second quarter of this century, the most potent influence of American progress and civilization. It developed the Northwest by giving an outlet to the commerce of the Great Lakes, and it made New York the Empire State, and New York City the imperial mart of the New World.

For twenty years after its size was increased to its present capacity it also continued to play a prominent part in our internal commerce. Contemporaneous, however, with its enlargement began that wonderful development of the railway system of transportation which has since absorbed the skill and resources of our profession, the best executive and administrative talent, and much of the available capital of our country, to the exclusion of water routes, so that our neglected canal, unchanged for thirty years except as to the gradual deterioration of its structure, with unimproved equipment and modes of operation, despite the liberal policy of the State, is gradually losing its capacity for usefulness and its influence on the problem of transportation. Thirty years ago the Erie Canal carried nine-tenths of the freight traffic between Buffalo and New York, while now it carries less than one-fifth of it. In view of these facts thoughtful men begin to ask themselves the question what must its future be.

For some years friends of this canal have urged minor improvements which, if promptly adopted, would have measureably increased its capacity and economy and prolonged its ascendency, but its inadequacy to meet the present and prospective wants of the Northwestern commerce seeking the East and the sea have now become so manifest and so great as to demand a far more radical and extensive improvement.

It is clear to me that the canal, to become the permanent highway of this commerce, must have sufficient capacity to float the largest vessels navigating the Great Lakes from Lake Erie to the deep waters of the Hudson, and in view of the fact that the draft of the lake vessels is now limited by the dimensions of St. Mary and St. Clair Canals, which may hereafter be enlarged, the locks of our canal should be large enough to provide for the probable increase in the size of lake vessels.

The canal should be at least 18 feet deep, and 100 feet wide at bottom, and its locks should be 450 feet long and 60 feet wide. The successful occupation of the

canal thus enlarged requires that it should receive its water from the lake and discharge it into the Hudson on account of the insufficiency of water tributary to its route to supply it.

This and various topographical and economic considerations render a radical change in parts of the route and profile of the old canal essential.

These changes are entirely practicable and involve no very serious difficulties.

The essential change in profile consists in extending the Rome level westward to Lock 57, between Newark and Lyons, in Wayne County, throwing out the locks 47 to 56, inclusive. This change in profile can be effected by swinging the route to the southward, near Newark, crossing the Canandaigua outlet and occupying ground of the proper elevation along the south side of Clyde River, and crossing the Seneca River at the narrowest part of its valley, which is near its junction with the outlet of Cayuga Lake, from whence it should gradually approach the present route of the canal, and connect with or cross it just east of the city of Syracuse.

The only serious difficulty encountered on this route is the crossing of the Seneca River, where the water surface of the canal must be nearly 50 feet above that of the river, and for nearly 2 miles over 40 feet above the surface upon which its embankment must be built.

This change of route, to secure a continuously descending profile from the lake to the Hudson River, is the only deviation from the route of the old canal that is absolutely necessary, but I think the construction would be simplified and cheapened, and the best possible waterway secured, by the adoption of an entirely new route from Syracuse eastward.

Lower ground can be obtained for the Rome level, except at the summit itself, by moving the line northward, thus, by lowering the elevation of this level throughout, lessening the difficulties of the Seneca River crossing, and from a point a little west of Utica eastward to the Hudson, the Mohawk River should be canalized by the erection of locks and movable dams at suitable points in its course, and the deepening and rectification of its channel.

From the mouth of the Mohawk, at Troy, to the deep water of the Hudson River, below Coxsackie, that river must be improved by narrowing and deepening its channel, or a canal must be constructed along its shore. The former method of construction affords, in my judgment, the simplest and most useful means of securing the desired result.

The plan may, therefore, be summarized as the widening, deepening, and necessary rectification of the worst curvatures of the present canal, from Buffalo to Newark, about 130 miles, the construction of a new canal from Newark to Utica, about 115 miles, the canalization of of the Mohawk River from Utica to Troy, about 100 miles, and the improvement of the Hudson River from Troy to Four-Mile Point, in Coxsackie, a distance of about 30 miles.

The elevation of the western level of the canal being governed by the surface of Lake Erie, must secure the required depth wholly by deepening, while the profiles of the levels from Lockport east can be adjusted to meet the economical requirements that will be disclosed by detailed surveys.

The first level from Buffalo to Lockport will be 32 miles long. Descending from this level at Lockport, by two locks, each of about 25 feet lift, the second level of the canal will be reached. This level, 64 miles in length, will extend to Brighton, where, descending by two locks of about 24 feet lift, we reach the third level of the canal, extending from Brighton to Macedon, 20 miles, there descending by a lock of about 20 feet lift, we reach the fourth level extending from Macedon to Newark, 12 miles, where, by a lock of about 20 feet lift, is reached the level of the proposed new canal, to extend from Newark to Utica, about 115 miles, which will be the fifth and longest level of the new canal. From that point the Mohawk River (except at Little Falls and Cohoes, where combined locks will be required) can best be canalized through locks of 10 or 12 feet lift, making pools having an average length of about 5 miles each.

The construction of this great artificial river, more than 300 miles long, involving as it does so vast a structure, which must be built in a manner to attain absolute security and permanence, the acquisition of large areas of land, the maintenance of the drainage of the country it traverses, and the erection of swing bridges at all necessary crossings, is a vast enterprise, both in engineering and in finance. It is a problem, however, that cannot be accurately stated even, either in a financial or in an engineering sense, until detailed surveys furnish data for detailed plans and estimates, and until a careful compilation of industrial statistics furnish the means of judging the volume of tonnage it will probably command. Judged by the cost of similar undertakings and what is already

known of this route, its cost may be roughly assumed at one hundred and twenty-five to one hundred and fifty millions of dollars, and from the commercial statistics at hand its probable tonnage may be placed at twenty to twenty-five millions tons per annum.

The first requisite to the possible inauguration of this enterprise is, of course, a careful system of surveys that will determine its probable cost, and whether it be undertaken by private enterprise, as most of the great artificial transportation lines of the world have been, by the aid of the National Government, or by the State itself, every consideration of State interest and State pride requires that it should remain forever under the sovereign control of the Empire State, and she should, without delay, cause the necessary surveys and estimates to be made for determining all the elements of this problem.

Let us consider the importance of this water way. For the past four years the average grain rates from Chicago to New York during the season of navigation have been by rail 14.9 cents, by lake to Buffalo and thence by rail to New York, 12.1 cents, and by lake and canal to New York, 9.9 cents per bushel.

The large propellers of the lakes have, however, during this period, found a profit in carrying grain from Chicago to Buffalo at 2 cents a bushel, while the cost by canal from Buffalo to New York, though the distance is only half as great, without tolls, but including the cost of transfer, has, at the same time, been more than 4 cents per bushel, more than twice the cost, and more than twice the time in transit for one-half the distance.

In the enlarged canal, making due allowance for reduced speed in the narrow channel and for lock detentions, the propeller would make the trip from Buffalo to New York in as short a time as she requires between Chicago and Buffalo, and thus deliver her cargo from Chicago to New York in less time and at less cost than can now be done by canal from Buffalo to New York. Such a realization would establish the commerce of New York on an enduring basis, never to be shaken by any development of trade, or combination of circumstances, that now seem possible.

All the great railway systems of the West, north of Arkansas and Texas, terminate at lake ports, and their prosperity and very existence depend on the diversion of all the business they can control to these ports, and with this canal enlarged, all the heavy freights that reach those ports, bound east, are destined by the laws of trade to take the water route, as being cheaper than any rail transit yet dreamed of.

Within the network of these railway lines, or grouped about the Great Lakes themselves, lay the great grain fields of the country, its principal forests and mines, as well as the chief part of its inland cities.

They must all become tributary to this canal if enlarged, and offer in commodities suited to canal transportation a larger volume of tonnage than the world has ever seen concentrated on an artificial line of transportation.

The importance of this enterprise increases with the rapid growth of our population and the consequent changing social and economic conditions of the country. Our productive capacity is beginning to exceed the demand. Our foreign grain markets are threatened with new competition from India and Australia.

If our national prosperity is to continue, we must reach foreign markets with our manufactures, and thus, by increasing the manufacturing class, create new home demands for our surplus food.

To reach these markets we must cheapen the goods by lessening the cost of living to the operatives, and also the cost of bringing together the raw materials requisite to manufacturing processes, and of sending the manufactured products to market.

With our wide-spread territory, cheap transportation is the chief agency in effecting these economies, and the Erie Canal, joining the granaries, the mines, and the forests of the West with the manufactories of the East, should be endowed with the necessary capacity to effectually realize the ideal of the political economist as to transportation.

I have thus crudely presented the salient feature of this problem to my professional brethren, in the belief that it must soon become an urgent engineering question, and trusting that they will give it thorough consideration and aid in giving it intelligent form, and, if found worthy, in commending it to popular appreciation.

TABLE I.—*Floating equipment on the Great Lakes, 1886.*

[From the U. S. Census, 1890.]

Classification of vessels.	Number of vessels.	Net tonnage of vessels.	Valuation of vessels.
Total	1,997	634,652	$30,597,450
A—Structure:			
Side-wheel steamers	43	14,150	1,494,500
Propellers under 1,000 tons	335	177,402	9,475,100
Propellers between 1,000 and 1,500 tons	72	86,728	5,935,000
Propellers over 1,500 tons	21	34,868	2,645,000
Tugs	466	11,737	2,497,600
Schooners	730	183,792	5,398,850
Barges	330	125,975	3,151,400
B—Material:			
Steel	6	6,459	694,000
Iron	35	22,714	2,675,000
Composite	2	63	39,000
Wood	1,954	605,416	27,189,450
C—Sail or steam:			
Steam vessels	937	324,885	22,047,200
Sailing vessels	1,060	309,767	8,550,250

TABLE II.—*Floating equipment on the Great Lakes, 1890.*

Classification of vessels.	Number.	Tonnage.	Value.	Increase.
Total	2,055	826,360	$58,128,500	$27,531,050
A—Structure:				
Side-wheel steamers	42	16,949	2,209,500	715,000
Propellers under 1,000 tons	431	154,232	13,905,600	4,430,500
Propellers between 1,000 and 1,500 tons	122	151,611	11,804,000	5,869,000
Propellers over 1,500 tons	110	188,390	17,737,000	15,092,000
Tugs	448	12,520	2,778,250	280,650
Schooners	577	158,620	4,726,150	----------
Barges	325	144,038	4,968,000	1,816,000
B—Material:				
Steel	68	99,457	11,964,500	11,270,500
Iron	39	24,673	2,638,000	----------
Composite	13	13,554	1,465,000	1,426,000
Wood	1,935	688,676	42,061,000	14,871,550
C—Sail or steam:				
Steam vessels	1,153	523,702	48,434,350	26,387,150
Sailing vessels	902	302,658	9,694,150	1,143,900

TABLE III.—*Quantities of grain, flour, and meal received at the ports named below each year from 1883 to 1890, inclusive.*

[From annual reports of New York Produce Exchange.]

Ports.	1883.	1884.	1885.	1886.
New York:	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
By canal, via river	41,220,908	37,925,257	29,930,587	44,036,522
Coastwise and river	3,725,238	2,417,962	3,738,304	2,132,370
By rail	79,390,091	75,076,847	92,968,540	84,741,170
Total New York	124,336,237	115,420,066	126,637,431	130,910,062
Portland, Me	3,200,506	7,934,194	6,363,916	5,867,150
Boston	37,527,022	34,520,298	31,166,368	35,769,884
Philadelphia	22,333,384	20,339,131	23,189,449	21,314,992
Baltimore	35,847,124	33,119,610	34,299,861	38,772,444
New Orleans	18,373,230	12,981,300	11,305,012	12,799,283
Total United States, Atlantic ports	241,617,503	224,314,599	233,162,038	245,433,815
Montreal, Canada	18,096,455	17,554,523	15,814,616	21,098,527

Ports.	1887.	1888.	1889.	1890.
New York:	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
By canal, via river	46,011,000	34,921,275	33,995,895	30,185,400
Coastwise and river	1,414,708	3,474,619	2,436,407	1,609,551
By rail	80,075,096	68,556,476	76,118,054	90,218,719
Total New York	127,500,804	106,052,370	112,550,356	122,013,670
Portland, Me	6,398,824	5,999,878	8,069,901	6,649,636
Boston	31,921,497	29,401,549	30,189,053	30,815,742
Philadelphia	25,038,809	17,158,523	18,460,942	35,214,826
Baltimore	39,252,205	30,275,840	42,349,047	46,435,135
New Orleans	16,853,936	12,030,865	20,812,159	21,575,442
Total United States, Atlantic ports	246,966,075	200,919,025	232,431,458	262,704,451
Montreal, Canada	19,891,891	14,018,520	17,659,337	17,444,966

NOTE.—Receipts at New York, Portland, Boston, Philadelphia, and Baltimore include shipments from the West to foreign countries through these ports on through bills of lading. Receipts at Portland via Montreal are duplications of receipts reported at Montreal. Receipts at Baltimore include flour ground by city millers (526,191 barrels in 1890) and exported. Receipts at New Orleans do not include shipments of oats and corn through that port to foreign countries on through bills of lading.

Grain embraces flour as wheat, corn, rye, oats, barley, malt, and pease.

TABLE IV.—*Receipts by all routes at New York for the year 1890.*

	Various.	Total rail.	River and coast.	Canal.	Total water.	Total rail and water.
Flour ..... barrels	142,053	5,475,338	160,046	.....	160,046	5,635,384
Meal ..... do	246	179,833	4,120	.....	4,120	183,953
Meal ..... sacks	2,358	461,149	13,212	.....	13,212	494,361
Wheat ..... bushels	20,375	6,366,925	151,332	9,276,600	9,427,932	15,794,857
Corn ..... do	420,400	17,913,400	75,866	16,272,200	16,348,066	34,261,466
Oats ..... do	150,200	32,180,200	7,100	1,556,700	1,563,800	33,744,000
Barley ..... do	10,450	2,183,800	424,140	1,687,700	2,111,840	4,295,640
Rye ..... do	19,056	534,477	66,716	627,200	693,916	1,228,393
Malt ..... do	15,166	4,164,166	121,272	741,100	762,372	5,026,538
Peas ..... do	53,150	595,100	14	23,900	23,914	619,014
Total grain	688,797	63,938,068	846,440	30,185,400	31,031,840	94,969,908
Flour ..... bushels	639,239	24,639,020	720,207	.....	720,207	25,359,227
Meal ..... barrels	5,700	1,641,630	42,904	.....	42,904	1,684,534
Grand total	1,333,736	90,218,718	1,609,551	30,185,400	31,794,951	122,013,669
Per cent	1.09	73.94	1.32	24.74	26.06	100

TABLE V.—*Official annual statement of lake and canal rates, Buffalo, December 4, 1890.*

Date.	Wheat.		Corn.	
	Lake rates per bushel, from Chicago to Buffalo.	Canal rates per bushel, from Buffalo to New York.	Lake rates per bushel, from Chicago to Buffalo.	Canal rates per bushel, from Buffalo to New York.
	Cents.	*Cents.*	*Cents.*	*Cents.*
May 31	1.69	3.98	1.41	3.59
June 30	2.20	3.75	1.91	3.35
July 31	2.26	3.63	1.25	3.13
August 31	1.50	3.92	1.25	3.43
September 30	1.88	3.93	1.62	3.43
October 31	1.98	4.02	1.72	3.52
November 30	2.16	3.86	1.97	3.30
Average	1.95	3.87	1.69	3.39

TABLE VI.—*Statement of the tons of property moved on the Erie Canal of New York for eleven years.*

[From the report of the superintendent of public works of New York for 1891.]

1880	4,608,651	1886	3,308,642
1881	3,598,721	1887	3,840,513
1882	3,694,364	1888	3,321,516
1883	3,587,102	1889	3,673,554
1884	3,389,555	1890	3,303,929
1885	3,208,207		

TONNAGE.

The whole number of tons of freight carried upon the canals of New York during the season of navigation of 1891 was 4,563,472 tons, and was composed of the following-described class of articles:

Product of the forest	1,206,986
Agriculture	1,171,192
Manufactures	109,387
Merchandise	250,083
Other articles	1,825,824
Total	4,563,472

TABLE VII.—*Annual average freight rates per bushel of wheat for transportation from Chicago to New York for each year from 1857 to 1890, inclusive.*

[Prepared by Mr. J. C. Brown, statistician New York Produce Exchange.]

Calendar year.	Average rates per bushel.			Calendar year.	Average rates per bushel.		
	By lake and canal. *a*	By lake and rail.	By all rail.		By lake and canal. *a*	By lake and rail.	By all rail.
	Cents.	*Cents.*	*Cents.*		*Cents.*	*Cents.*	*Cents.*
1857	25.29			1874	14.10	16.9	28.7
1858	16.28			1875	11.43	14.6	24.1
1859	17.59			1876	9.58	11.8	16.5
1860	24.83			1877	11.24	15.8	20.3
1861	26.55			1878	9.15	11.4	17.7
1862	26.33			1879	11.60	13.3	17.3
1863	22.91			1880	12.27	15.7	19.9
1864	28.36			1881	8.19	10.4	14.4
1865	26.62			1882	7.89	10.9	14.6
1866	29.61			1883	8.37	11.5	16.5
1867	22.36			1884	6.31	9.55	13.125
1868	22.79	29.0	42.6	1885	5.87	9.02	14.00
1869	25.12	25.0	35.1	1886	8.71	12.00	16.50
1870	17.10	22.0	33.3	1887	8.51	12.00	*b*16.33
1871	20.24	25.0	31.0	1888	5.93	11.00	*b*14.50
1872	24.47	28.0	33.5	1889	6.89	*b*8.70	15.00
1873	19.19	26.9	33.2	1890	5.85	8.50	14.31

a Including canal tolls until 1882, but not Buffalo transfer charges.
b Averages of officially published tariffs.

TABLE VIII.—*Annual average canal freight rates on wheat and the tolls on wheat from Buffalo to New York, and the elevating and storage rates at Buffalo for each year from 1870 to 1890, inclusive.*

[Prepared by Mr. William Thurstone, secretary of the Buffalo Merchants' Exchange.]

Year.	Average canal freight rates.	Tolls.	Elevating, including storage. *a*	Year.	Average canal freight rates.	Tolls.	Elevating, including storage. *a*
	Cents.	*Cents.*	*Cents.*		*Cent s.*	*Cents.*	*Cents.*
1870	11.2	3.1	1.25	1881	4.7	1	.875
1871	12.6	3.1	1.25	1882	5.4	1	.875
1872	13	3.1	1.25	1883	4.9		.875
1873	11.4	3.1	1.25	1884	4.2		.875
1874	10	3.1	1.25	1885	3.8		.875
1875	7.9	2	2	1886	5		.875
1876	6.6	2	2	1887	4.5		.875
1877	4.4	1	1	1888	3.4		.875
1878	6	1	1	1889	4.8		.875
1879	6.8	1	1	1890	3.8		.875
1880	6.5	1	1				.875

a Storage varied; five to ten days the limit.

TABLE IX.—*Freight charges per ton per mile on the following trunk railroads of the United States and on the New York State canals, from 1870 to 1889, inclusive.*

Railroads and canals.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
New York Central *a*	1.884	1.649	1.593	1.573	1.462	1.275	1.051	1.014	.914	.80
Pennsylvania *b*	1.549	1.389	1.416	1.415	1.255	1.058	.892	.980	.918	.796
New York, Lake Erie and Western *a*	1.333	1.435	1.526	1.454	1.312	1.209	1.099	.955	.973	.78
Boston and Albany *a*	2.193	2.09	2.016	1.958	1.818	1.533	1.288	1.208	1.129	1.11
Philadelphia and Erie *b*	1.303	1.205	1.192	1.135	.977	.865	.776	.786	.628	.512
Lake Shore and Michigan Southern *b*	1.504	1.391	1.374	1,335	1.18	1.01	.817	.804	.734	.642
Michigan Central *b*	1.982	1.747	1.867	1.891	1.569	1.398	1.115	.878	.848	.692
Chicago, Burlington and Quincy *b*	2.392	2.2	2.076	1.921	1.901	1.889	1.603	1.428	1.247	1.023
Chicago and Northwestern *c*	3.093	2.869	2.614	2.351	2.226	1.946	1.789	1.702	1.724	1.56
Chicago, Milwaukee and St. Paul *b*	2.82	2.54	2.43	2.50	2.38	2.10	2.04	2.08	1.80	1.72
St. Louis, Iron Mountain and Southern *b*	------	------	------	------	2.63	2.20	2.05	1.98	1.92	1.88
Chicago, Rock Island and Pacific *d*	------	2.64	2.49	2.29	2.07	1.92	1.91	1.71	1.56	1.43
Illinois Central *b*	------	------	2.16	2.20	2.09	1.93	1.80	1.82	1.64	1.52
Chicago and Alton *b*	------	------	------	------	2.124	1.879	1.626	1.447	1.298	1.054
Pittsburg, Fort Wayne and Chicago *b*	------	------	------	1.41	1.26	1.10	.93	1.01	.88	.76
Chesapeake and Ohio	------	------	------	------	------	------	------	------	------	.858
Maine Central	------	------	------	------	------	------	------	------	3.32	2.87
Mobile and Ohio	------	------	------	------	------	------	------	------	2.29	2.48
Average on railroads	2.005	1.923	1.896	1.803	1.750	1.554	1.386	1.320	1.401	1.249
New York State canals	.835	1.027	1.016	.887	7.43	.668	.679	.564	.42	.46

a Year ending September 30.
b Year ending December 31.
c Year ending May 31.
d Year ending March 31.

TABLE IX.—*Freight charges per ton per mile on the following trunk railroads of the United States, etc.*—Continued.

Railroads and canals.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.
	Cts	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
New York Central *a*	.88	.78	.73	.91	.83	.68	.76	.78	.77	.76
Pennsylvania *b*	.88	.799	.817	.819	.740	.673	.755	.73	.634	.686
New York, Lake Erie and Western *a*	.84	.805	.749	.780	.685	.628	.636	.662	.669	.649
Boston and Albany *a*	1.20	1.04	1.07	1.19	1.09	.94	1.10	1.17	1.08	1.02
Philadelphia and Erie *b*	.56	.55	.62	.62	.58	.50	.52	.54	.519	.52
Lake Shore and Michigan Southern *b*	.75	.62	.63	.728	.652	.55	.639	.67	.636	.664
Michigan Central *b*	.842	.718	.77	.83	.65	.56	.686	.694	.694	.726
Chicago, Burlington and Quincy *b*	(*c*)	(*c*)	(*c*)	(*c*)	(*c*)	(*c*)	(*c*)	(*c*)	(*c*)	(*c*)
Chicago and Northwestern *d*	1.49	1.47	1.42	1.42	1.31	1.19	1.19	1.10	1.02	1.03
Chicago, Milwaukee and St. Paul *b*	1.76	1.70	1.48	1.39	1.29	1.28	1.17	1.09	1.01	1.06
St. Louis, Iron Mountain and Southern *b*	2.08	1.76	1.50	1.66	1.47	1.41	1.30	1.26	1.22	1.12
Chicago, Rock Island and Pacific *e*	1.21	1.22	1.28	1.17	1.10	1.40	1.07	1.01	.93	.97
Illinois Central *b*	1.54	1.52	1.42	1.43	1.37	1.31	1.16	1.09	.95	1.03
Chicago and Alton *b*	1.206	1.24	1.26	1.13	1.01	1.01	.96	.95	.92	.92
Pittsburg, Fort Wayne and Chicago *b*	.92	.74	.75	.79	.67	.58	.69	.71	.66	.69
Chesapeake and Ohio	.869	.891	.793	.723	.672	.548	.541	.536	(*d*)	(*d*)
Maine Central	2.74	2.74	2.75	2.42	.239	2.46	2.17	2.33	2.10	2.03
Mobile and Ohio	2.20	2.06	2.15	2.28	1.97	1.70	1.51	1.32	1.01	.96
Average on railroads	1.292	1.215	1.188	1.888	1.087	1.028	.992	.974	.926	.928
New York State canals	.49	.38	.42	(*f*)	(*f*)	(*f*)	(*f*)	(*f*)	(*f*)	(*f*)

a Year ending September 30. *c* No data. *e* Year ending March 31.
b Year ending December 31. *d* Year ending May 31. *f* Tolls abolished.

TABLE X.—*Annual average through freight rates on grain, flour and provisions (per 100 pounds) from Chicago to European ports, by all rail to seaboard and thence by steamers, from 1880 to 1890.*

[Prepared by Secretary of the Board of Trade, Chicago.]

Shipped to—	Articles.	1880.	1881.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
		Dolls.	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*
Liverpool	Grain	.4922	.3718	.3647	.4428	.2943	.3672	.3487	.3490	.3958	.3187
Do	Sacked flour	.5433	.3499	.4030	.2982	.2887	.3420	.3491	.3371	.4162	.3625
Do	Provisions	.6871	.4670	.5183	.4674	.3508	.4415	.4073	.3747	.5746	.5109
Glasgow	Grain	------	.3932	------	.2641	.3228	.3910	.3705	.3605	.4075	.3550
Do	Sacked flour	.5651	.4400	------	.2811	.3443	.3951	.3968	.3579	.4425	.4188
Do	Provisions	.6732	.5361	------	.4789	.4086	.5329	.4855	.4658	.6142	.5833
London	Grain	------	.3620	------	.2783	.2921	.4086	.3945	.3802	------	.3550
Do	Sacked flour	------	.4276	------	.3825	.3171	.4021	.3784	.3776	.4510	.4047
Do	Provisions	------	.5550	------	.4891	.4046	.5471	.4781	.4570	.6196	.5813
Antwerp	----do	.7385	.5708	.6295	.5373	.4327	.5219	.4961	.4472	.6094	.4688
Hamberg	----do	------	.5471	.6279	.5434	.3842	.5154	.5229	.5426	.6262	.5260
Amsterdam	----do	------	------	.6683	.5434	.4383	.5562	.5525	.5426	.6500	.5000
Rotterdam	----do	------	------	.6683	.4354	.4383	.5562	.5508	.5426	.6500	.5000
Copenhagen	----do	------	------	.7158	.5434	.4951	.5169	.5508	.5483	.6492	.5813
Stockholm	----do	------	------	.8255	.5904	.5468	.5543	.5865	.6671	.7500	.6094
Stettin	----do	------	------	.7420	.5422	.5210	.5833	.5508	.5483	.6492	.6813
Bordeaux	----do	------	------	.6432	.5603	.5066	.5708	.6021	.5821	.7491	.6650